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December 7, 1922

Engineering News-Record

Automobile Dump Cart Depositing Concrete in the Marseilles Lock

Building the Marseilles Lock on the Illinois Waterway

Motor Truck Tractive Resistances; An Investigation

By T. R. Agg

Reconstructing a Railway Bridge at Newburyport, Mass.

Simple Aerial Photography for Practising Engineers

By F. H. Tibbetts

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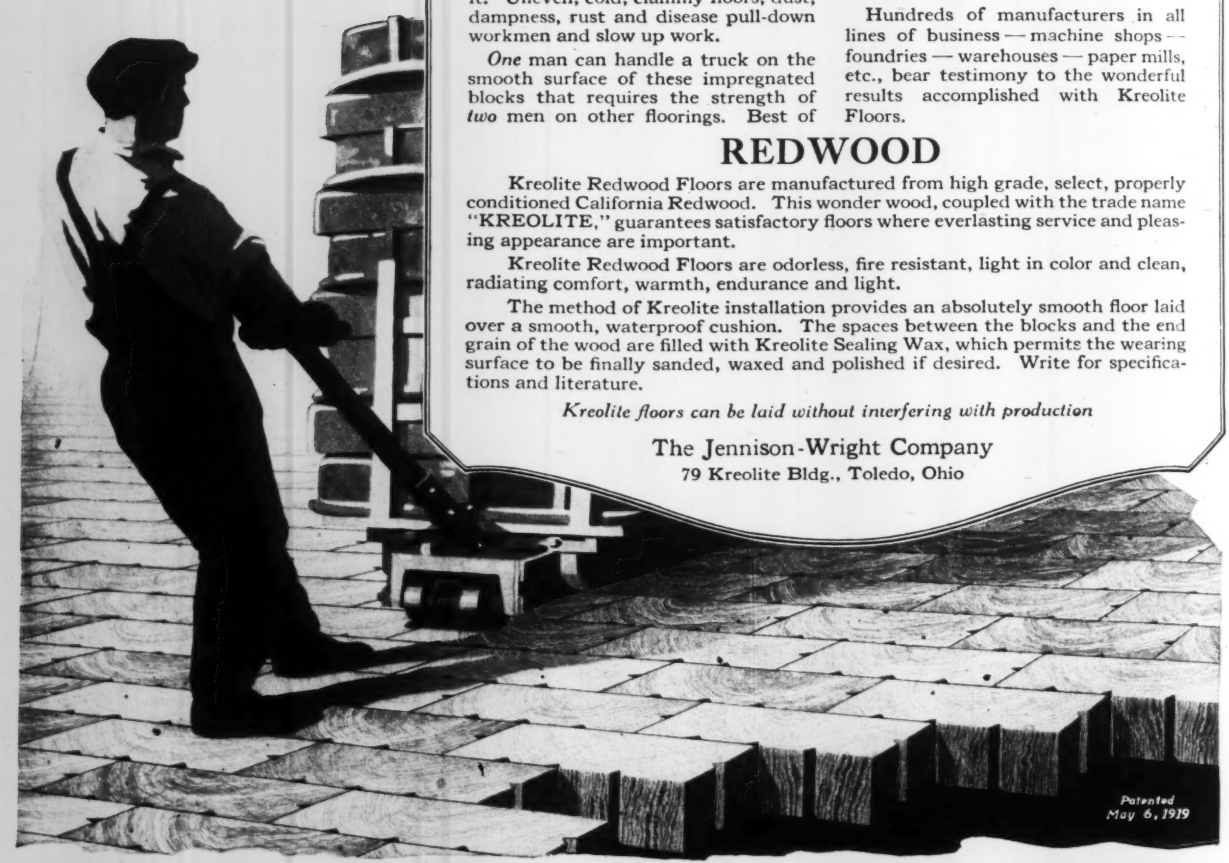


WOOD BLOCK FLOORS

A Consolidation of Engineering News and Engineering Record — McGraw-Hill Company, Inc.—JAMES H. McGRAW, President

ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. MEHREN, Editor

Volume 89 — NEW YORK, DECEMBER 7, 1922 — Number 23

A Ray of Hope

ENCOURAGEMENT is to be derived from the announcement by President Butler of Columbia University that in the budget of 1922 the committee on education had recommended to the trustees the creation of ten professorial positions each to pay $10,000 a year and twenty-five such positions each to pay $7,500. Meagre salaries for college and university faculties have come almost to be accepted as an inevitable feature of educational practice, and it is stimulating to see a professorship listed with a $10,000 salary even prospectively. While this announcement deals only with the higher grades in the ranks of the teachers, it sets up a standard that sooner or later must exert a beneficial influence upon salaries all the way down the line.

An Interstate Pact

NO NATURAL problem in the United States today is as far-reaching or so varied in its implications as the control and development of the Colorado River. Every one of the seven states through which it flows wants its water for power and irrigation and those lying in its lower alluvial plane must in addition have protection against its overflowing banks in time of flood. Beside this the federal government has concern with its potential navigability and its relation to the foreign country through which it passes to the sea. Millions must be spent on the Colorado in this generation but hardly a cent can be spent until some amicable agreement is reached between the bordering states as to their respective rights and privileges. Such an agreement has just been signed by the states' representatives but will not be effective until ratified by the legislatures which will meet within the year. The compact signed at Sante Fe is obviously a compromise but it is a fair compromise upon which a start toward construction can be made, especially by the federal government which must initiate, at least, the great work on the river. Obstruction on the part of any one state now can only hold back progress to the detriment of that state as well as its neighbors.

Typhoid from a Cross-Connection Again

ANOTHER addition has been made to the list of typhoid outbreaks due to a cross-connection between a municipal and an industrial water supply, this time in New Jersey. The Franklin Furnace outbreak, noted in our News of the Week section, is unusual in that both the industrial and municipal supplies are owned by the same company and in that no charge is made for water supplied for domestic use. It seems to be a case of cross-connection unknown to the operating officials, protected by a single check valve that, as so often happens, didn't protect. The check valve, it seems, has gone untested because its existence was unknown. How to ferret out these forgotten or neglected cross-connections is a question for water-works and health board men. The fact that this particular cross-connection and valve probably admitted polluted water to the municipal system during an underwriters' fire test suggests that whenever such tests are made on fire-protection supplies known to be or suspected of being cross-connected with domestic supplies, some one of the highly colored chemicals available for the purpose be introduced in the fire-protection supply and looked for at taps connected with the domestic supply.

What is Sand?

SOME months ago in discussing in these columns the difficulties of technical nomenclature, mention was made of the ambiguities lurking in the definition of so simple a material as sand. In Washington just now this has official exemplification in a case before the Treasury Department. In the new tariff law "sand, crude or manufactured" is on the free list and "silica, crude" is taxed $4 per ton. "When is silica sand," and vice-versa, are questions now being asked the Customs Division. An accepted authoritative definition of sand would no doubt help the government in its ruling. The obligation resting collectively on engineers to establish precise nomenclature extends far beyond the immediate needs of the profession.

Building Piers to Order

MUCH mystery surrounds the exact status of the great shipping-pier group which the city of New York has built at Stapleton, on the harbor side of Staten Island, but it is evident that the lessees are anything but happy in their possession of the piers and are trying to get out of such contracts as they may have made. Such a situation is a condemnation of the city's theory of pier layout, which has been repeatedly criticized on other grounds. The city, it will be remembered, holds that piers are intended to accommodate the steamship companies who lease them and that the lessee's wishes as to design are governing. On that basis the Stapleton piers were designed, with resulting details far from those approved by the consensus of expert engineering opinion. These details, it was answered, suit the lessees. They are paying for them; the city gets a fair return on its investment. What more could one ask? The answer has now come. The lessees, at least some of them, do not want the piers and there is a fair chance that they cannot be made to keep them, so the city is left with some special made-to-order goods and the job of finding someone they will fit. How much better it would have been to make standard goods and then try to market them.

Adding to Knowledge

IT HAS already been suggested in these columns that the construction of every engineering work gives occasion for researches which will improve the work itself and in addition will add to the general knowledge of the profession. The column tests for the Philadelphia-Camden suspension bridge, outlined in this issue, afford an

instance of such researches. Though a committee had been occupied with column testing for nearly ten years, rather recently, many important detail questions remained untouched, among them that of web strength. Hence the present tests. Unless we mistake the attitude of the engineers of this great work, the tests described will not be all or even the largest part of the research work likely to be carried out in connection with the bridge, but every major point in which doubt as to most economical or safest proportioning appears will be studied both by analytical calculation and by practical test. The undertaking thus will be utilized to the full for adding to the stock of engineering knowledge. We assume that the same spirit will prevail in dealing with the details of the tests, so that, for example, the results will be studied not only for the conclusions of immediate importance to the tower design but for all the facts and conclusions contained in the test data. There is room, as every one knows, for more knowledge in the delicate and always interesting field of column design. Similarly, there is room in many other departments of engineering for fuller and more precise knowledge. Every investigation that is made to help in the construction of an engineering work can be made to contribute some of the missing knowledge and advance the efficiency of the engineer's art.

Departmental Reorganization

PERSISTENT rumors come from Washington that the long sought reorganization of the government departments will be presented to Congress at this session. Let us hope that it will. There has been altogether too much pussyfooting and inside maneuvering in the two years since the Brown commission started its study of the departments. It is time that some tangible scheme be brought onto the floor of Congress and its merits and its defects exposed in the ensuing committee hearing. The economies which will result from a proper rearrangement of the federal bureaus are just as self-evident as are certain the struggles with which most of those bureaus will resist such rearrangement. Let us get the discussion out into the light where everyone can see wherein lies the opposition and can evaluate it.

Aerial Photographs by the Engineer

ANY reasonably good amateur photographer using an ordinary camera can take photographs from an airplane that are of value in engineering work. Suggestions for work of this sort are presented in the article by F. H. Tibbetts in this issue, in which he makes clear the distinction between accurate vertical aerial photos for mapping and oblique aerial photographs taken to give perspectives and to serve general utility purposes. Accurate aerial maps call for trained operators and special photographic apparatus not commercially available. Perspective or bird's-eye views, on the other hand, such as can readily be made by the amateur with equipment to which he is accustomed, have proved so useful in engineering work done by Mr. Tibbetts that he urges other engineers to consider their use. Instead of thinking of aerial photographs as something entirely out of reach, or at best to be contracted for with an aerial photographer, it is urged that an airplane and pilot, now available for commercial work in all parts of the country, be employed by the engineer and that he make the flight himself, taking such pictures as will be useful and at the same time gaining the advantage of an aerial reconnoissance.

An engineer's duty is ordinarily but half done when he has obtained a correct solution of the technical problem presented. He must convince non-technical but vitally interested citizens, voters, directors and executives of the merits of the work which he recommends and must keep the general public informed concerning the progress of construction work in which it should have an interest. Aerial photography furnishes one of the most promising fields for informing, educating and interesting the public in great public enterprises. Looking at the matter from a broader viewpoint, it should be remembered that although the conquest of the air has been a peculiarly American achievement, future air supremacy, a matter of overwhelming military importance, will depend in large degree upon the maintenance of a trained aviation personnel in peace times. Pride in a great American invention, far-seeing patriotism and scientific interest, as well as practical results on the particular piece of work in hand, should all combine in enlisting the support of the practising engineer in the more extended and more general use of the airplane and aerial photography.

Credit to the Old

IN THIS era of ultra-heavy railroad standards and daily retirement of old track and structures for heavier ones, it is refreshing to learn that a bridge built in the days of wrought iron and light loads has done its work regularly for nearly thirty-five years and is unimpaired. Many features of the arrangement and construction of this bridge might be called into question, in spite of the fact that it was designed by one of the masters of the bridge engineering art of a former generation, Theodore Cooper; but its service record silences these questions and vindicates Cooper's judgment and skill. The case is a timely reminder of the truth that the engineering of the past will bear comparison with that of the present. Although each year fewer of the old-time works survive the demands of modernization, most strikingly so in the field of iron bridges, we may still learn from what our predecessors did, whether we see it in its surviving form or must take it from printed records. The new generations can learn from the past.

Every art as it becomes more fully developed tends to follow fashions—it becomes conventionalized in a way, or, as we like to say nowadays, standardized. However excellent the elements of the preferred, selected practice, the engineer who uses them will nevertheless miss something if he does not retain part of the versatility and greater freedom of thought that characterizes earlier stages of development. In bridge practice this is particularly true. The stimulus or even inspiration flowing from the works of earlier masters is vital to the power of bridge engineering thought. Herein lies the distinguishing value of the study of an old-time structure, even when of such plain and apparently routine type as the old Newburyport bridge.

Much more valuable, however, than the historical feature of the case is the remarkable instance which it presents of continuing old material in full-efficiency service in spite of the handicap of different inherent strengths of the original and the added metal. The reconstruction shows the faith which the engineer may properly place in an old structure on careful scrutiny

of its service record and its condition. The engineers of the Boston & Maine are entitled to all possible credit for having the courage to use the old on the same rating as though it were new. Further, the method by which the steel and the wrought iron are combined and each is given its appropriate stress affords an instructive model. The part played by the transverse members in distributing the load by making the structure integral as regards deflection is exactly the same as that played by the floorbeams in the latest reconstruction of the Poughkeepsie cantilever bridge, where the old three-truss structure formerly proportioned for double-track loading now carries a single track.

After noting the various interesting details of the reinforcement method, the reflections of the engineer who reads of the work are likely to turn back again to a fundamental question at issue in its planning: whether a wholly new bridge should be built or the old one brought up to full strength by reinforcement. A difference in cost was involved in this decision, and also the somewhat less tangible question of the desirability of a reinforced bridge. On the latter point different engineers entertain sharply different views. Many are inclined to favor new construction and—unjustly, we think—to place a low valuation on a reinforced structure, as being a piece of patchwork. The decision reached on the Boston & Maine tends to oppose this latter attitude, and to strengthen regard for old material and old structures by showing in a practical way how they can be applied at full value to the service of today.

Common Sense Garbage Disposal

EVERY city that is contemplating heavy capital outlay and uncertain, but surely considerable, operating expense for garbage disposal, or that feels itself burdened with expense and other troubles incident to existing means of disposal, should weigh carefully the experience of Seattle, Wash., reviewed at length on p. 876 of our issue of Nov. 23. In a sentence, Seattle scrapped three refuse incinerators of the British type after three years of use and for seven years past has got rid of its garbage at relatively low cost by the "sanitary fill" method of disposal—dumping garbage, ashes and other refuse in low places and keeping the dump surface and slope covered with earth or ashes.

From the Seattle experience it does not follow that every other city should abandon incinerators or reduction works or hog feeding if any one of these means of garbage disposal is in use, or should pass by all these methods for the sanitary fill in case the problem is being faced for the first time. The two first principles to be observed here as in any other field of engineering are (1) that each well tried method available for solving the problem in hand should be considered in view of all local governing conditions and (2) that the experience of other cities with all these methods should be studied and each given its proper weight, again in the light of the local conditions of the city immediately concerned.

A strong reason for close study elsewhere of the Seattle experience before adopting plans for garbage disposal is that incineration, particularly in high-temperature destructors, was strongly advocated in many quarters for two decades as by far the best method of garbage disposal for American cities. Disposal by reduction was often and unwisely scored as necessarily unsanitary. If hog feeding was mentioned it was only to be condemned. Disposal by dumping was also scored, usually without recognition of the fact that a light covering of dirt or ashes, as is practiced at Seattle and has been practiced at smaller places under intelligent direction, would convert an objectionable dump into a sanitary fill. And beyond all this, it was urged that garbage disposal is a vital public health matter and that fire is the only safe means of disposal.

What every city needs to know and act upon today is that fundamentally garbage disposal is a matter of city cleansing rather than of public health, and that the main object in choosing a method of disposal and operating a disposal plant is to get rid of the garbage at the lowest possible cost consistent with the production of a reasonable minimum of offense to sight and smell. In addition, every city needs to know that the country is dotted with abandoned garbage disposal plants, of all types; due partly to unwise original choice of method to suit the local conditions, partly to poor design by inexperienced engineers and promoters, but most of all to failure of the appropriating and administrative authorities of our cities to recognize that garbage and refuse disposal is an engineering problem, as regards both the design and *operation* of plants.

Unfortunately most of the engineers of the country, even those in the municipal service, know little about garbage disposal. For a hundred engineers who have specialized in water or sewage treatment we have only one or two who have mastered garbage disposal. Consequently in the all-too-rare cases where a city council or board calls on some member of the city engineering staff for advice, the chief gain is not in having the advice of an experienced specialist, but in getting an engineering view of the problem. That is an unquestioned gain in all cases and a great gain in some, but it does not take the place of advice from a specialist, and but few of our cities have engineering staffs from which a competent man can be detached and given time to inform himself as to garbage disposal.

Until conditions in garbage disposal as a part of the general city administration and also as a branch of municipal engineering are improved, it would be a wise course for every city to go slowly in choosing or changing a method of garbage disposal. This is particularly true just now in view of the present high costs of construction and operation of garbage disposal plants and of the low revenues from such methods of disposal as produce a return that helps reduce cost.

For some cities the sanitary-fill method practiced at Seattle would serve at relatively small cost for at least a few years, while for other cities, mostly smaller ones, burial in shallow trenches would be cheap and satisfactory. Hog feeding, under intelligent supervision—but no more intelligent than is needed to operate a destructor or reduction plant—deserves continued trial. As for either incineration or reduction, let every city beware until one or the other has been advised by a competent garbage specialist, after as long and detailed an investigation of local conditions as may be necessary, with particular attention to the relation between collection and final disposal. And even if the specialist advises incineration or reduction, let every city government shun either unless there is assurance of placing and keeping the plant in the hands of a competent chief operator, keeping the operating staff out of politics and, last but not least, unless there is a fair chance that following city administrations will not refuse appropriations essential to proper plant operation and upkeep.

Construction Methods and Plant on the Marseilles Lock

River Between Mixer and Lock Crossed by Cableway, Movable Bridge and Ferry Boats — Excavation Kept Just Ahead of Concrete to Avoid Disintegration of Shale Foundation

METHODS of transporting materials to the site were the controlling construction problems in building the Marseilles lock of the new Illinois waterway near Lockport, Ill., particularly as the Illinois River is between the lock and the nearest railway. At the lock site the width of the river in round figures is about 700 ft. Flood water and ice in large volume in spring and fall characterize the stream and any means of across-river carriage had to take these conditions into account. A secondary controlling factor was the blue shale rock of the lock foundations. This shale disintegrates rapidly into clay and excavation was controlled by the progress which could be made in concrete construction since the foundation bed could not be left long uncovered. Altogether the excavation amounted to 243,000 cu.yd. and the concrete to 60,000 cu.yd., with 89,000 lb. of reinforcing metal.

Marseilles lock as described in *Engineering News-Record*, Dec. 2, 1920, p. 1095, is one of a series of locks on the new waterway, a planned improvement to make the Desplaines and Illinois rivers navigable for 6-ft. barge transportation between Lockport and Utica, Ill. It is a concrete structure about 938 ft. long overall with a lock chamber width of 110 ft. The concrete is contained chiefly in the side walls, which are gravity walls, with filling and discharge culverts in their lower sections. The site is on dry land away from the river with which connection will be made by future canals. Water has caused no serious trouble. Indeed, except for the river intervening between lock site and railway and for the poor rock bed, practically no natural conditions entered to complicate the construction problem.

From the construction viewpoint the outstanding operations were: Plant layout, excavation, and concrete work. It should be noted also that a form of contract was employed which put the burden of risk for fluctuating prices and wages largely on the owner. Each of these factors of the work is considered by itself.

Plant Layout—An electric railway parallels the right or north bank of the river across from the lock. There are also highways on both sides of the river. The electric railway was selected as the main route for delivering material and a spur was swung south and forked into yard tracks as shown by Fig. 1. By this arrangement all materials were brought in car loads to the yards where a locomotive crane did the switching and unloading. Prior to the construction of the yard tracks some hauling to the lock site was done by trucks from Marseilles over the road on the south bank.

With the completion of the yard tracks means of transportation across the river were undertaken. At first a ferry was established to haul supplies. Above the ferry a stationary cableway of about eight tons capacity and a span of 1,300 ft. was erected on 100-ft. towers. This cableway handled materials and served also the secondary purpose of installing and dismantling the movable wooden bridge located directly underneath.

Concrete materials formed the bulk of the freight brought into the yard and as they had to be unloaded here it seemed logical instead of trans-shipping them across the river to do the mixing at the yards and haul the mixed concrete across the river. Truck haulage

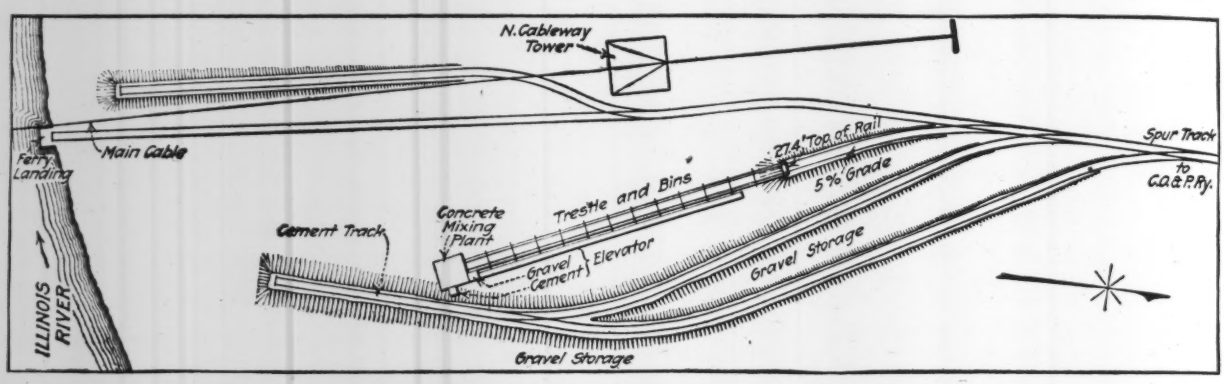


FIG. 1—CONTRACTOR'S YARD LAYOUT ACROSS RIVER FROM MARSEILLES LOCK

was decided on and the bridge mentioned provided the roadway across the river. It was designed to be removable because a fixed bridge, which would withstand the high water and ice, could not be installed at a reasonable price. A permanent bridge which would meet the requirements for navigable river crossings was not warranted by any future use to which it could be put. The removable bridge then was the distinctively novel feature of the construction plant.

A bridge 700 ft. long of the design shown by Fig. 2 was constructed so that it could be disconnected and removed or set up in units as indicated by Fig. 3. Dowel pins in the bottoms of the posts were sufficient to anchor the bents to the soft shale of the river bottom when the water was 8 ft. deep and had a current of 3½ miles. Normally the water was only 4 ft. deep. About 75 M. ft. b.m. of lumber were required. Each bent was designed for a load of two trucks carrying a cubic yard of concrete each. The bridge has been removed and installed every fall and spring and in emergency has been dismantled in a few hours.

The structures described, with the storage and mixing units, which are described farther on, and with shops, offices and a camp for the workmen, completed the plant. The work of installation was begun Nov. 6, 1920, and continued during the fall and winter.

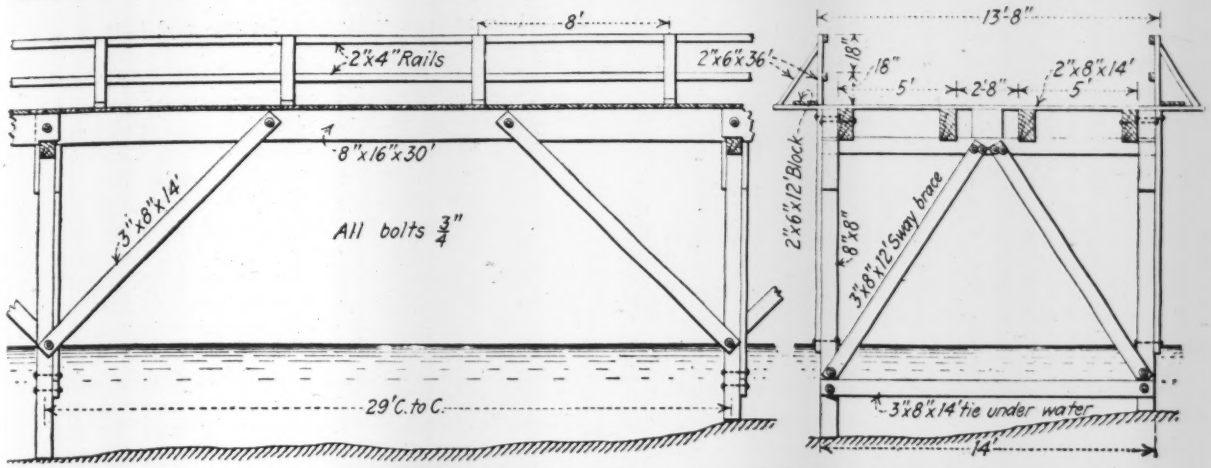


FIG. 2—REMOVABLE BRIDGE FOR TRUCKS HANDLING WET BATCHES

Excavation—There were about 116,000 cu.yd. of earth and 127,000 cu.yd. of rock to be removed for the lock emplacement. Some 40,000 cu.yd. of the earth were taken out with teams and graders and the remainder with a small steam shovel loading into wagons. The rock was a blue shale which had to be blasted but broke very easily and disintegrated quickly when exposed. Well drills put down 20 and 30-ft. holes for the main cut and jackhamers were used for trimming blasts and breaking large blocks. The material was excavated and loaded into 9-cu.yd. 30-in.-gage dump cars by a railroad-type steam shovel. Three-car trains hauled by dinkies took the spoil to dumps on both sides of the lock. Here on the shallow dumps good service was given, pulling down the dumped spoil by a portable backfiller for trenches. This device, it was estimated, saved 20 to 30 men which otherwise would have been needed to keep the fill pulled down so as to give the cars a clear way for dumping.

In the final cut which shaped the rock for the concrete, very slow progress was made purposely. The shale could not be left long uncovered without going to pieces and so the work was done no faster than space was needed for placing concrete. In these circumstances efficiency and output records signify nothing important. In fact this statement is true of the whole lock construction. At any reasonable rate of progress the lock would be completed long before it could be of any possible use and so the contractor was not held to specified progress and found it preferable not to hurry.

Concrete Construction — All concrete (about 60,000 cu.yd.) is mixed on the north bank and hauled in wet batches to the lock. It is proportioned 1.3 bbl. cement to 1 cu.yd. of bank-run gravel, to make 1 cu.yd. in place. Fig. 1 shows the location of the mixing plant at the end of one of the yard tracks and in relation to the other plant units and the stockpiles. An inclined trestle about 200 ft. long carries the track approaching the mixing plant and is arranged as shown by the section, Fig. 4, to form a bin for the gravel which is brought in hopper-bottom cars. A 24-in. belt conveyor 175 ft. long, with a capacity of 50 cu.yd. per hour, takes the gravel through traps in the bin floor and delivers it to the boot of a bucket elevator delivering into a bin above the mixers. The trestle storage provides for two or three days' supply and adjacent stockpiles provide for emergencies.

Cement is received in bulk and the cars are unloaded

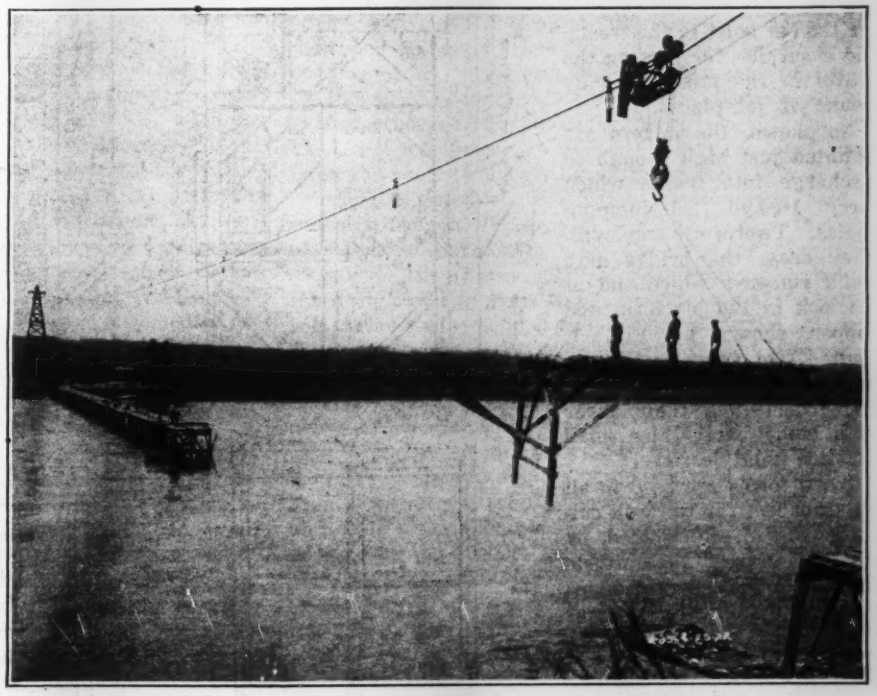


FIG. 3—CABLEWAY ERECTING REMOVABLE BRIDGE
View shows mixing plant and head-tower of cableway at the contractor's yard. The lock is on the side from which the view is taken.

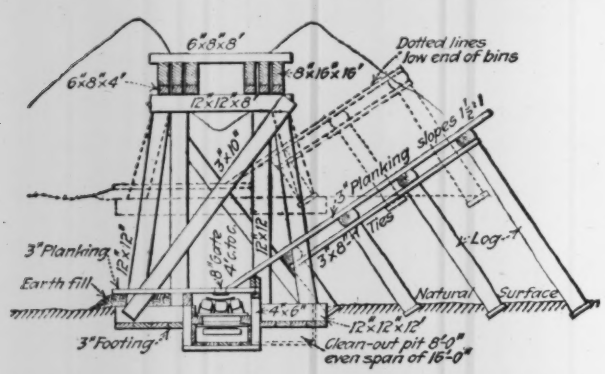


FIG. 4—SECTION OF GRAVEL STOCKPILE TRESTLE

by an automatic power unloader into the boot of a bucket elevator delivering to a bin above the mixers.

Three or four carloads can be handled in a day. The cement bin holds about 500 bbl. and there is a house for an emergency stock in bags. The contractors have found bulk cement to be more economical to handle than cement in bags.

The mixing plant, as shown by Fig. 5, is a notably compact structure with a duplicate mixer installation. Separate power units, measuring devices and bin gates make the operation of each mixer absolutely independent. Each mixer is 1-cu.yd. wet-batch capacity. Two 50-hp. upright boilers supply steam for the mixer engines, two engines for the elevators, one engine for the car hoist in the trestle and a surplus for heating the gravel in the mixer bins by means of jet pipes.

As shown, the mixers are mounted just high enough to discharge into trucks which carry 1-cu.yd. self-dumping bodies. Twelve are employed. They cross the bridge onto plank runways which end at the lock in the platform and hopper shown by Fig. 1. Chutes lead from the hopper to the place where concrete is being deposited, their lower ends being carried by small portable hand derricks.

Wood forms are used in all places except for the wall culverts which are molded by steel forms. For the uniform sections of the walls the forms are mounted on car trucks for shifting and when in use are blocked up and braced. The steel forms for the culverts consist of separate upper and lower sections as half of the culvert is molded with the footing and half with the lower section of the wall.

Records of concrete placing signify little for the reasons stated in discussing excavation. At no time has the capacity of the plant been reached and at times 600 cu.yd. of concrete have been placed in a day.

Contract Practice—As the contract was let in October, 1920, when wage scales were still unsettled and prices and freight rates were uncertain, a special form of contract was drafted by which the state assumed the major part of the risk due to possible increase. Briefly, a schedule of wages and prices was agreed upon. It was then provided that if any increase occurred in either, the state should absorb 80 per cent and the contractor 20 per cent. Any increase in freight rates was to be absorbed wholly by the state.

While this contract met the 1920 situation and got reasonable bids and, indeed, has worked well enough, it would probably not be considered for use again under present conditions. One principal fact brought out was that the ratio of price or wage increase or decrease to be absorbed by the contractor is too small. His gain is so

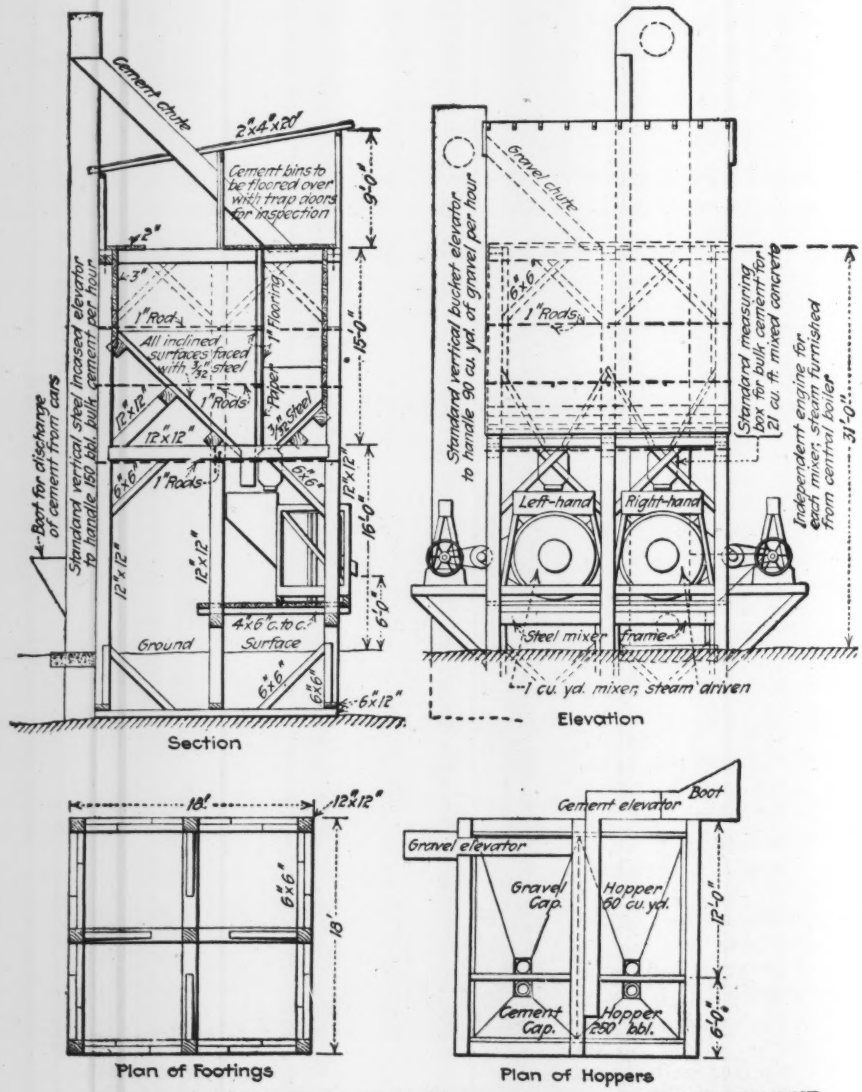


FIG. 5—DETAILS OF MIXING PLANT WITH DUPLICATE MIXER EQUIPMENT

FIG. 6—DUMP-BODY TRUCK HAULS WET BATCHES
Receiving their loads at the mixing plant these trucks crossed the removable bridge onto plank runways ending at the lock in the dumping platform shown.

little from a reduction that he will not make great effort to force wages down if there seems to be a prospect that by so doing trouble may be had with the men. As an emergency resort the special contract proved valuable but it will not be employed in future work for the waterway.

Outstanding Features—Reviewing the lock construction operation the things which stand out prominently are:

1. Placing concrete by a procession of small handling units any of which can be dropped out without affecting the efficiency of the others is believed to be more flexible and to give greater assurance of continuous output than large capacity single unit concrete transporting devices.

2. Wet batches hauled up to 2,000 ft. suffered no deterioration that called for remonstrance by inspectors. Seldom more than 10 minutes elapsed from the time the mixer was discharged until the concrete was deposited in the forms.

3. By wet-batch haulage in trucks an opportunity is afforded of choosing a location for mixing plant and stockpiles far enough away from the structure to get advantages of space not possible near it.

The Men in Charge—The Illinois Waterway Project was planned and construction started under the direction of the Waterways Division of the Illinois State Department of Public Works. M. G. Barnes is chief engineer of the Waterways Division and L. D. Cornish is assistant chief engineer. Roy Shackleton is superintendent and Ralph A. Bonnell is engineer for Green & Sons Co., the contractors. The state is represented by J. Bassett, division engineer at Ottowa, and Ralph S. Heath, resident engineer on the work.

French Hydro-Electric Developments

Of a total of 2,100,000 hp. of electrical energy at present in use in France, 650,000 hp. is for lighting, heating, and minor power; 1,300,000 hp. for industrial use; 50,000 for traction purposes; and 100,000 for agricultural and other miscellaneous uses. French industries are being educated to the substitution of electricity for steam power wherever electrical energy can be made available, and although the market in France for American machinery and equipment is hampered at present by the depreciation of French exchange, a much greater demand for American goods of this nature will most certainly accompany the return to more normal conditions.

Small Iron Removal Plant for the Water-Works of Leroy, Ohio

Aerator, Roughing Filter and Rapid Sand Filter Treat Well Water for Town Built by Ohio Farmers Insurance Co.

By A. Elliott Kimberly
Consulting Engineer, Columbus, Ohio

In January, 1922, the Ohio Farmers Insurance Co., of Leroy, Ohio, placed in service a small water-works comprising a flowing well, low-service pumping station, iron removal plant, high-service pumping station, a 50,000-gal. elevated tank and about 1.37 miles of 6-in. cast-iron pipe. Leroy is in the southwestern portion of Medina County and has a population of about 300. The town was virtually created by the insurance company to provide for its home offices and to house its officers and other employees, who comprise practically the entire population. The rock waters of Medina County are hard and high in iron, and in two other instances, namely at Wadsworth and Lodi, plants have been provided for the removal of iron. Since the design of the Leroy plant has one or two interesting features, a description of it with some analytical data may be of interest to those concerned in iron removal from other chalybeate waters of this type.

Source of Supply—The flowing well at Leroy, originally drilled for gas, is located about 0.9 mile west of the center of the village. In drilling, a large vein of water was struck about 75 ft. beneath the surface and about 38 ft. in the Cuyahoga shale. When gas operations were abandoned, an 8-in. capped casing was left in the upper part of the hole. The water is under artesian pressure and in the summer of 1921 gave a measured flow of approximately 0.15 m.g.d. The water flows into a pump well, whence it is forced to the iron removal plant about 1,600 ft. distant.

In developing its properties, and in providing for the housing of its employees, the Ohio Farmers Insurance Co. has made Leroy a very picturesque village under the guidance of experienced landscape engineers. On this account it was necessary to locate the water plant away from the center of the village and to make it as inconspicuous as possible. Particular attention was paid to the architectural features of the building so that the plant would harmonize with the type of structures already built at Leroy. These considerations controlled the design of the plant which provides separate pumping stations for low and high service with the arrangements for iron removal installed within the high-service pumping station building.

Iron Removal Plant—The iron removal plant comprises an aerator, roughing filter, rapid sand filter and clear well, housed in a 31 x 36-ft. brick structure. The water from the low-service pump enters the aerator and then flows successively to the roughing filter, sand filter and clear well. The plant was designed for a capacity of 150,000 g.p.d., and provision is made for a second filter unit.

Aerator—Under a residual pressure of from 8 to 10 lb., the raw water enters a pipe reservoir, located on the roof of the pumping station building, and constructed of 8-in. cast-iron pipe, supported in a concrete basin 10 x 22 ft. in plan, covered to a depth of 12 in. with 1 to 3-in. limestone. At either end of the pipe reservoir are five No. 4 1¼-in. Binks spray nozzles, ⅛-in. orifice, each

with a capacity of about 11.2 g.p.m. at 10 lb. pressure. The aerator is completely surrounded with a wooden louver 10 ft. high.

Roughing Filter—The aerated water flows into a perforated grid supported above the roughing filter. The latter is a concrete tank 10 x 6⅔ ft. in plan containing 6 ft. of ¾ to 1½-in. limestone. The roughing filter is provided with valves for backflushing and is so designed that when idle, free passage of air takes place within the limestone "contact" material.

Sand Filter—The main or sand filter, which contains no features differing essentially from standard practice, consists of a concrete box having an area of 65 sq.ft. and containing 23 in. of Ottawa sand with an effective size of 0.40 mm. and a uniformity coefficient of 1.5, supported by a 4-in. layer of coarse (torpedo) sand, this in turn resting upon 17 in. of graded gravel. The underdrains comprise a manifold of 8-in. cast-iron pipe tapped with lines of 2-in. galvanized-iron pipe provided with ½-in. holes on the lower side. Wash water is applied at a rate of 20 in. vertical rise per minute from a 5,400-gal. tank. The filter is provided with five hand-operated valves and the rate of filtration is controlled by a float valve and orifice. The filtered water enters a 25,000-gal. circular, covered concrete clear well located outside of the pumping station.

Basis of Design—An analysis of the flowing well water made in June, 1921, showed 8 p.p.m. of iron, 45 parts of free carbonic acid and practically no dissolved oxygen; total hardness, 563; alkalinity, 397; incrustants, 166; sulphates, 439.

Evidences of rapid oxidation of the iron following the escape of the carbonic acid were noted around the well,

ANALYSES OF RAW AND TREATED WATER AT LEROY, OHIO, AUG. 29, 1922.

Source	Temperature Deg. F.	Iron (Fe) P.P.M.	Free CO_2 P.P.M.	Dissolved Oxygen P.P.M.	Dissolved Oxygen Per Cent Saturation
Flowing Well	54	2.0	64	0.0	0.0
Aerator	63	0.0	20	9.6	98.4
Roughing filter	62	0.0	19	8.6	87.3
Sand filter	61	0.0	23	6.8	68.4
Tap at hotel	69	0.0	23	3.2	35.2

suggesting that aeration would be very effective as the initial treatment. A number of iron removal plants provide settling basins following aeration, but from analytical data made available to the writer through the courtesy of the Engineering Division of the Ohio State Department of Health, it appears that but little iron is removed by plain sedimentation; that is, in the Ohio plants studied, the filters carry practically the entire burden. With the thought of finding a method of relieving the work of the filters, careful inquiry was made regarding American and foreign iron removal practice. In his work on iron removal ("Enteisenung von Grundwasser"; Leipsic, 1905), Darapsky expresses the law of ground-water deferrization, which, freely translated, is as follows:

> The removal of iron from water requires the very intimate admixture of an excess of air (oxygen), following which, to secure coagulation, the aerated water must be subjected to the catalytic action of previously precipitated iron sludge. The required time of contact is inversely proportional to the relative quantity of oxygen introduced.

It thus appears that the successful removal of iron from water is a two-stage proposition: (1) Removal of the free carbonic acid by very thorough aeration and oxidation of the ferrous iron by the oxygen thus absorbed and (2) the coagulation of the colloidal iron. The second stage is, of course, accomplished in sand filters at the expense of wash water, but is also effected by contact of the oxidized semi-colloidal ferric iron with previously precipitated iron sludge in basins or towers containing coarse, rough material. Such devices are illustrated by the towers and roughing filters containing coke, brick, wood, gravel, stone and slag provided at many plants.

In applying these principles to the plant at Leroy, it was decided to provide nozzle aeration producing a very fine spray and to cause the spray to fall 6 to 8 ft. into a collecting tray or shallow reservoir containing 12 in. of very coarse limestone. Built upon the roof of the building with louver protection, and with free circulation of air at all times, considerable removal of carbonic acid and excellent aeration were anticipated.

As a second step, preparatory to final filtration through sand, a roughing filter was provided to effect the coagulation of the oxidized iron. The rate of superficial filtration is approximately 97 m.g.d. per acre or 1.543 gal. per square foot per minute. It may be said in passing that the efficiency of the roughing filter appears to be related to the time of contact with the filtering material so that the superficial area is not so much a criterion as is the volume and the actual surface area of the filtering material from top to bottom. It is therefore essential to use fairly coarse, rough, hard material. According to Piefke ("Handbuch d. Hygiene," Rubner, v. Gruber, Ficker, II Band, 2 Abt. s. 95), coke is not suitable for hard water. He recommends broken brick, broken tile or waste blocks of wood.

To permit the free passage of air through the roughing filter, the water is applied to the surface of the filter through a perforated grid system and further the elevation of the high-water line in the final sand filter is below the bottom of the roughing filter. The roughing filter is cleaned by backflushing to the surface of the filtering material and the sudden opening of a drain valve. It is, of course, not advisable to remove the ferric iron completely but merely to restore the clogged filter to normal quantitative performance. The sand filter is designed on the basis of a rate of filtration of about 100 m.g.d. per acre or 1.603 gal. per square foot per minute. The upper sand is slightly coarser than often required in mechanical filtration practice.

Operating Results—In August, 1922, after about seven months' operation, tests were made to determine the efficiency of the plant in the removal of the iron and the carbonic acid. The tests included the collection of samples of the raw water, the effluents from the aerator, roughing filter, sand filter and the tap water in the center of the village. Based upon the operating records of the plant, it appears that the daily consumption averages about 20,000 gal., with a maximum of 40,500 gal. and a minimum of 11,000 gal. The maximum demand is incident to lawn sprinkling during the hot, dry summer months.

From the analytical data shown in the accompanying table, it appears that the iron is entirely removed by the 12 in. of coarse stone in the aerator. Note also the large volume of oxygen introduced by the sprays and the corresponding decrease in the quantity of carbonic acid. So complete is the removal of the iron by the aerator and roughing filter that the sand filter is washed on an average of only once in eight days. It is obvious that

The roughing filter is a most effective substitute for the usual settling basin, not only accomplishing a complete removal of iron, but also reducing in a marked degree the volume of wash water required in the operation of the plant. These results strikingly support the evidence obtained in other plants in Ohio to the effect that the passage of the aerated water through some type of roughing filter or tower is much to be preferred to sedimentation as a preparation for final sand filtration.

The Leroy water-works and other improvements (which included sewers and sewage-works) were constructed on force account under the direction of Carl R. Frye of Elwood & Frye, landscape architects and engineers, Columbus, Ohio, as contractors. H. G. Noble was resident engineer for the contractors. Robert R. Reeves, Miller & Reeves, architects, Columbus, Ohio, designed the architectural features of the iron removal plant building. The improvements were designed by the writer and the construction work was supervised by him. The approximate cost of the water-works was $45,000.

Culvert Failure and Replacement for Drainage District

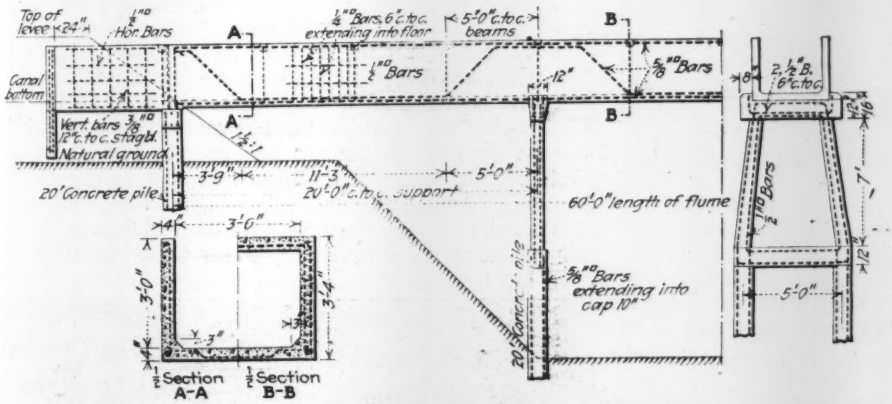
Old Drainage Pipes in Quicksand Rust and Crush, Causing Failure of Irrigation Laterals

By W. F. Heath

Assistant Engineer, Cameron County Water Improvement District No. 2, San Benito, Texas

When Cameron County Drainage District Number Three started construction work in 1914, it became necessary, in crossing the canals of the San Benito Land & Water Co., to install either culverts in the drains or else carry the canals over the drainage ditches by means of flumes. The former method was chosen and a number of corrugated galvanized pipes in sizes ranging from 24 to 48 in. were installed. Some of these were built with brick headwalls; some had no headwalls of any kind.

CONCRETE FLUME CARRYING IRRIGATION LATERAL OVER WRECKED DRAINAGE CULVERT



DETAILS OF IRRIGATION FLUME OVER DRAIN

As early as the summer of 1919 some of these pipes had become so badly choked with sediment as to prevent the passage of drainage water. In some instances the water was held at such a level as to endanger the surrounding land, raising the water table and causing the land to become alkaline in places. In the spring of 1921 the drainage district started an intensive ditch-cleaning campaign, taking out the silt in the main drains down to the original grade. Several months after this work was completed Cameron County Water Improvement District Number Two (successors to the San Benito Land & Water Co.) woke up one morning and found that one of its main distribution laterals had caved in over one of the old corrugated iron culverts, putting the irrigation lateral out of service. A temporary wooden flume was built to carry the irrigation water. As the irrigation system was built before the drainage ditch the culvert naturally had to be replaced by the drainage district.

After a joint meeting of the drainage district commissioners and the engineering department of the irrigation company it was decided to carry the irrigation lateral over the drainage ditch by means of a concrete flume, thus giving a free passage for the drain water and insuring a permanent structure. This flume is 3 ft. high by 3½ ft. wide and carries 18 sec.-ft. of water with a freeboard of 8 in. and a total loss of head of about 0.1 ft. It has three 20-ft. spans in the barrel and a flaring intake and outlet, each 7 ft. long. The flume side walls were used as beams to carry the load.

The cost of the flumes was $1,250 (contract price); an amount not much in excess of that required to replace the culvert as it was before failure, since much of the excavation would have been in quicksand and shoring would have been necessary.

Since the first pipe failed, another has caved in and been replaced, and there are several more that are in a precarious condition. All of these failures are in the drains that have been recently cleaned out (the cleanout work instituted in 1921 was the first done since the drain ditches were built) and the cleaning evidently had something to do with the failure. There have been many theories advanced as to just what caused the failure, but the most logical explanation is that the dredging extended down into the quicksand and the flow of water around the pipe carried the quicksand from around and under the pipe. As the pipe had rusted badly the weight from above caused it to settle and break.

Protecting Steel Bridges from Locomotive Blast

Examination of Gunite and Reinforced-Concrete Casing of Floor System of Railway and Street Bridges in Chicago

HOW to protect the underside of steel bridges exposed to blast, smoke and gases from locomotives is an important and often troublesome problem in large cities where numerous bridges have a limited headroom over tracks carrying heavy traffic. The resistance of different methods of protection applied to some Chicago bridges is shown in the accompanying views. The results are comparable, as the clearance in all cases is about 17 ft. from the top of rail to underside of bridge.

In Fig. 1 is shown part of the underside of the bridge carrying the Chicago, Rock Island & Pacific Ry. over the Chicago & Eastern Illinois R.R. at 79th St. This is a gunite ceiling placed in 1914 by the Cement-Gun Construction Co., Chicago, under the direction of R. H. Ford, track elevation engineer (and now assistant chief engineer) of the former road. This view shows a portion of an expansion joint at a point where the engine blast is continuous and heavy. The white streak indicates where the blast has blown the surface clean of soot, but it will be noticed that the original pebbled surface is still intact and that even the corners of the expansion joint have not been rounded off in nine years of service.

FIG. 1—GUNITE CEILING OF 79TH ST. BRIDGE
Surface uninjured after nine years' exposure to locomotive blast.

Bridges over the tracks approaching the Chicago union station from both north and south afford examples of the service of various forms of steel protection under conditions of minimum headroom and heavy blast. Fig. 4 shows the girders and floorbeams of the Lake St. bridge, which were encased in concrete poured at the same time as the floor. This work was done in 1915 and so the concrete has been subjected to about eight years of service. The 3-in. concrete under the main girders has been worn away, exposing the steel, and at the right of this a hole has been worn through the 3-in. ceiling. The ends of the broken steel reinforcement are shown, and at the extreme right is an exposed reinforcing rod. The sidewalk slab at the left is badly cut, and beyond the part shown in the view some of the bars are exposed.

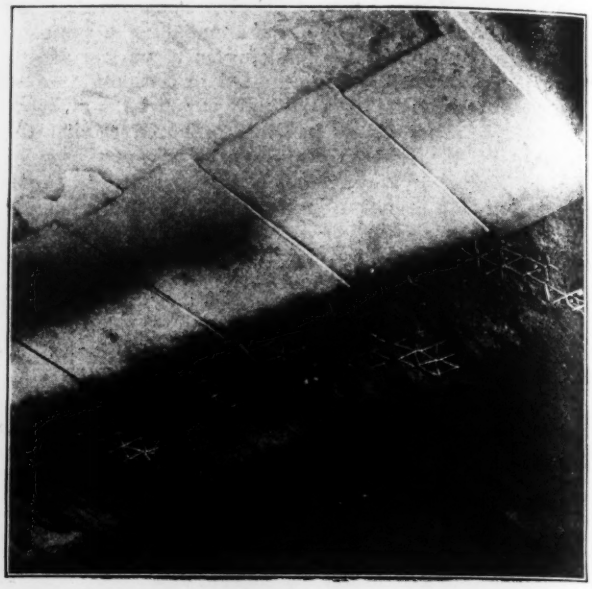


FIG. 2—EFFECT OF BLAST ON CONCRETE CASING
Condition after one year's exposure, with track center off center of blast plates, causing wear shown. Taylor St. bridge.

The underside of the Taylor St. bridge, built in 1920-1921, is shown in Fig. 2. Poured concrete was used for the steel encasement, with cast-iron blast plates over the tracks. At the time the photograph was taken the track had not been placed in final position, with its center line directly under the iron plates, so that part of the blast has been received by the concrete. In one year of service the concrete, both where subjected to the center of the blast and at the sides of the cast-iron blast plates which were not struck centrally, has been cut away so as to expose the reinforcing mesh. Fig. 3 shows the same bridge where the floor structure

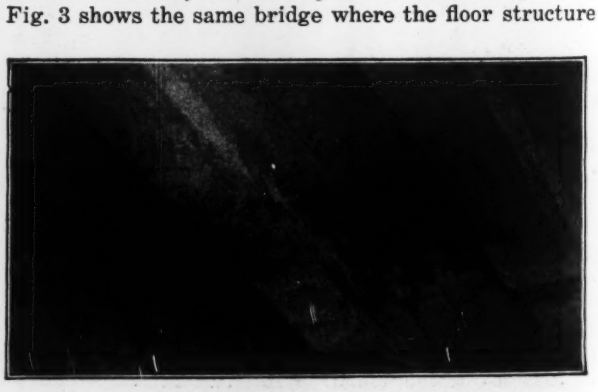


FIG. 3—BLAST WEAR ON CONCRETE UNDER SLAB
Cast-iron plates are on underside of beams. Taylor St. bridge.

is of a different type and where blast plates were placed on the concrete encasement of beams. Here also the concrete shows evidence of disintegration on the bottoms and sides of beams and the bottom of the floor slab.

At the Harrison St. bridge, two blocks north of the Taylor St. bridge and built at the same time, the main girders and beams were encased in gunite, while some of the smaller floor beams were encased in ordinary concrete, poured at the same time as the slab. Blast plates were embedded in the gunite on the underside of the main beams and girders. This gunite casing shows no signs of deterioration, but is in the same condition as that on the 79th St. bridge shown in Fig. 1. Poured concrete casing of the floor beams and the concrete slab, although at a higher elevation above the track, are showing evidence of pitting and deterioration.

Although gunite for the protection of steel is approved by engineers of the lines described, some conditions are noted as necessary to successful results. Surfaces to be covered must be clean and free from grease and dirt, the sand must be clean and suitable for cement-gun work, and the staging and apparatus must permit ready access to all parts and application of the gunite perpendicularly to the surface. Fresh surfaces must be disturbed as little as possible, the entire coating being applied as nearly as possible monolithic. The final surface must be left with proper finish, surfaces flat, edges straight and corners well formed. In order to accomplish this and to get maximum density and hardness, with absence of sand pockets, it is necessary to have the work done by experienced operators and foremen.

In some recent work where a concrete floor slab is used this slab encases the tops of the beams, the lower parts being then covered with gunite. It is considered questionable whether iron blast plates are necessary or desirable with gunite. The attachment of the plates to insure that their supports will not be destroyed introduces difficulties and the results at the 79th St. bridge seem to indicate that gunite alone is sufficient.

Experience with the Chicago bridges points to the following conclusions: (1) that with a headroom of 17 ft. from the track a gunite casing properly applied will resist locomotive blast for at least nine years without injury; (2) that blast plates may not be necessary if gunite casing is used; (3) that plain concrete in such positions and with limited head room is not likely to form durable protection. The photographs were furnished by the Cement-Gun Construction Co., Chicago.

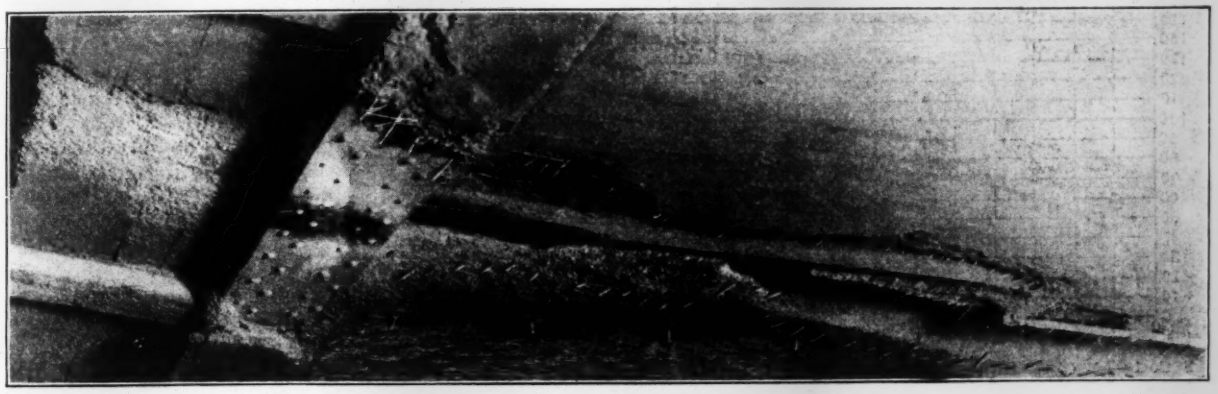


FIG. 4—CONCRETE CASING UNDER LAKE ST. BRIDGE
Condition after six years' exposure.

Company Versus State Management for Indian Railways

RAILWAY management by companies or by the state is a question of growing importance in India, as the contracts under which some of the large systems are operated by private companies expire in a few years.

Practically all of the railways are owned by the state but are operated under contract, the government guaranteeing the companies a low rate of interest but exercising very strict control and regulation. It was expected that the guarantee system would encourage private initiative, but this has not been the result, owing to the government's financial methods. On one hand the government has opposed the raising of capital by the companies and on the other hand it has failed to supply them with the funds necessary for development. In consequence the extension, improvement and equipment of the railway system is far behind actual needs.

A commission appointed recently to consider the situation failed to arrive at a definite conclusion, half the members favoring state management and the other half favoring company management. Inquiries are now being made of local chambers of commerce and the results indicate a strong disapproval of state management. This disapproval is based on the unsatisfactory results of the system in India after many years' experience and on similar unfavorable results in Europe.

Under the company system as now proposed the companies would be free to raise capital as required, up to a limit prescribed by the government. In the reply of the Bengal Chamber of Commerce the report of the above commission is quoted to the effect that "as railways are primarily commercial undertakings they should be managed on a commercial basis so as to secure economy and efficiency; that is to say, by a company with a board of directors."

Some defects of state management are said to be:

(1) Constant transfers of senior officials.
(2) A tendency to promotion by seniority.
(3) Disregard for public opinion.
(4) Lack of initiative and flexibility.

In support of these views it is pointed out that the chamber speaks from experience with both state and company management and has arrived at the conclusion that the public was better served by the company-managed lines than by the state lines.

Safe Yields of Drainage Areas In Years of Minimum Rainfall

Presentation and Discussion of Minimum Runoffs in Northeastern United States—Mass Curves To Show Safe Yields

By Alfred S. Burgess

Assistant Engineer, New York City Department of Water Supply, Yonkers, N. Y.

IN ESTIMATING the safe yield it is quite common practice to base it at least largely, if not entirely, on the stream flow which has actually taken place during the period of observation and measurement. This procedure would entail no material error provided that the period of observation and measurement happened to include years of low rainfall as near the minimum as could reasonably be expected from observations and records on other similarly situated drainage areas during a long period of years. While severe droughts have occurred from time to time on every drainage area, and will occur again in the future, the chances of a really severe one being included in a period of observation of say ten or fifteen years in a relatively small area is quite remote.

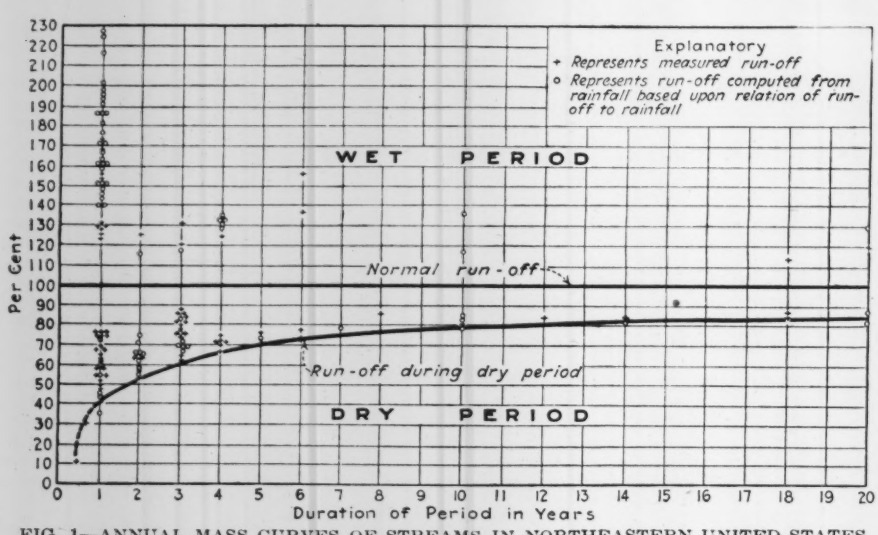


FIG. 1—ANNUAL MASS CURVES OF STREAMS IN NORTHEASTERN UNITED STATES

The accompanying diagram (Fig. 1) shows the stream flows that actually occurred during the most severe droughts on record in the northeasterly United States. It gives the relation, in percentages, between the normal yearly runoff, which is represented by 100 per cent, and the runoff that has actually occurred during continuous periods of low rainfall, varying in duration from 1 to 20 consecutive years.

A study of the runoff records for periods less than one year discloses the fact that during two or three consecutive months the runoff may be reduced in dry years to 10 per cent or less of the average annual rate for a normal year. If the drainage area contains large lakes or storage reservoirs we may expect, in like periods, occasional negative runoffs due to the evaporation from the water surfaces being greater than the stream flow.

The accompanying table gives the yearly fractional runoffs or percentages corresponding to the curve of low rainfall years shown in Fig. 1.

The periods of low runoff upon which Fig. 1 are based were the driest on record in the northeastern United States. The table giving the probable minimum stream flow shows that for a period of one very dry year the runoff may not exceed 40 per cent of normal. For two consecutive dry years it may amount to only about 52½ per cent of the runoff for two normal years.

If this two-year dry period includes one year with a runoff of only 40 per cent the runoff for the other year must necessarily be 65 per cent of the normal. On this supposition we may compute the third year as 78 per cent normal, fourth year as 81 per cent normal, fifth year 86 per cent normal, etc. It was found by several trials that the most critical conditions, except where the amount of water in storage is very large, are usually included in the three or four driest years. Hence, if we construct mass curves of 40, 65, 78 and 81 per cent normal yield, respectively, we may by placing these mass curves together in such order as to give the maximum depletion, ascertain the safe yield based upon the conditions given in the table of probable minimum stream flow. The method of constructing the mass curves and applying them to problems of this nature are clearly explained under Computation of Storage in "Public Water Supplies" by Turaure and Russell and under Storage of Water in "The American Civil Engineers Pocket Book."

In the application of this method of estimating the probable minimum yield and the supply that may be collected and stored, attention is called to the general features of the mass curves shown by Fig. 2. It will be noted that the curves indicate that runoff amounting to 25 per cent of the yearly total may be expected during the months of March and April and that at times the runoff during these two months may amount to one-half of that for the entire year.

Owing to this great variation and inequality in the monthly flows it can be readily appreciated that a considerable amount of the flow may be wasted even during dry periods, especially if the reservoirs are small in respect to the requirements of the watershed. The portion of the supply that can be utilized depends in a great measure upon the consumption and distribution of the flow during the year and also upon the distribution of the driest years in respect to the dry period. In order to arrive at a reasonable and reliable conclu-

PROBABLE MINIMUM STREAM FLOW DURING VERY DRY PERIODS

Continuous Periods, Years	Per Cent of Total Runoff for Equal Number of Normal Years	Continuous Periods, Years	Per Cent of Total Runoff for Equal Number of Normal Years
1	40	11	80
2	52½	12	81
3	61	13	81½
4	66	14	82½
5	70	15	82½
6	72½	16	83
7	75	17	83.5
8	76½	18	83.5
9	78	19	84
10	79	20	84

sion, it is essential that we thoroughly study the conditions in respect to low runoff which will be brought about by the reason of the dry period. This study should not only be made of the yield but also of the amount of water that will remain in the storage reservoirs at different times throughout the drought period. Such a study is most readily made by arranging the

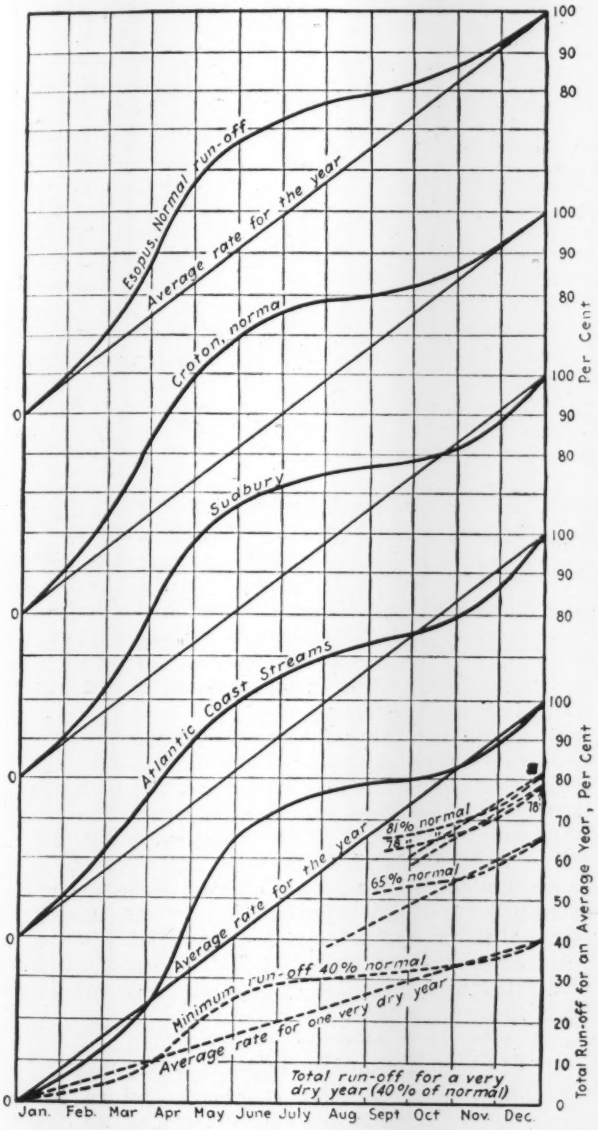

Esopus, Normal run-off
Average rate for the year
Croton, normal
Suabury
Atlantic Coast Streams
81% normal
78
18
65% normal
Average rate for the year
Minimum run-off 40% normal
Average rate for one very dry year
Total run-off for a very dry year (40% of normal)
Per Cent
Total Run-off for an Average Year, Per Cent
Jan. Feb. Mar Apr May June July Aug Sept Oct Nov. Dec.

FIG. 2—RELATION OF MINIMUM TO NORMAL RUNOFF

previously mentioned 40 to 81 per cent yearly mass curves of the stream under consideration in such relation that the maximum depletion during the dry period, and hence the safe supply, can be determined.

Objection will no doubt be raised to this method as being ultra conservative. It is true that yields as low as this method indicate are brought about usually by a combination of unfavorable conditions and will occur on a given watershed only at long intervals. On the other hand, we can never be sure just when these unfavorable conditions may arise and it is probable that the future has in store even drier periods than the ones recorded and upon which the diagram is based.

Locating and Mapping Highways in North Carolina

Standardized Methods and Centralized Control Have Increased Results and Reduced Costs—Railway Practice Copied

BY GEORGE F. SYME
Senior Highway Engineer, North Carolina State Highway Commission, Raleigh, N. C.

HIGHWAY location is costing less than a hundred dollars a mile in North Carolina. Including plans for construction the average cost is $117 a mile. These low costs are due to a very painstaking effort to standardize practice and to centralize control. The new methods have been employed only since the first of 1922, but they are the outgrowth of six years of study and experimentation.

Originally all surveys in a given district were conducted under the direct supervision of the district engineer, and the plans and preliminary estimates were prepared in the district offices. It appeared on study that plans could be more economically prepared at the main office in Raleigh; a large overhead expense was saved, and forces of draftsmen in the nine district offices were eliminated. A drafting force was therefore, assembled, at headquarters, under a chief draftsman, and divided into several squads of five men each,—one man in each squad serving as squad leader. It handled the field survey notes from all the districts and prepared plans, profiles and estimates.

It was next found necessary to standardize the methods of keeping field notes and other records. A notable reduction in the cost of preparing plans was at once observed.

When a survey of a given project was completed the locating party often was assigned to the construction. This was due largely to the urgent and immediate need for construction men. The important thing was, however, that when a new survey was ordered a new locating party had to be organized and put in the field. No experienced locating engineers were being developed.

Sectional Surveys—Based on its success in centralizing the drafting work, the commission finally concluded to reorganize its location forces with a view first to developing skilled locators, thus obtaining better locations and reductions in the construction and operating costs, and second, to reduce the cost per mile of making the surveys. A department of location was created and a principal locating engineer was appointed with headquarters at Raleigh. This department took over all location parties then in the field—about 26 in number. These parties were reorganized, so as to consist of a chief of party, transitman, levelman, front rodman, level rodman, chainman, stakeman, and axemen as needed. The front rodman serves as chainman, making seven men to the party, plus the axemen necessary.

The state was divided into three survey sections, i.e., Coastal, Piedmont and Mountain, and each section was placed in charge of an experienced locating engineer, reporting directly to the principal locating engineer at Raleigh. All of the party chiefs in a given section report to the locating engineer in charge of that section.

By these various changes the efficiency of the parties has been so increased that it has been possible to reduce their number from 26 to 14 and a further reduction to

12 parties is anticipated. This large reduction, however, was not wholly due to increased efficiency, but was partly owing to the fact that the reorganization disclosed that more men were in the field than were needed.

Before the organization of locating department the average mileage of completed location per month, per party, was 6.7 miles and the average cost of making it including all necessary preliminary surveys, subsistence, transportation, etc., was $110 per mile.

Under the present organization the average number of miles finally located per party per month is 9.7 miles, and the average cost, including all necessary preliminary surveys and all other expenses is $92 per mile, and further improvement is anticipated.

Gratifying as are the numerical results, they pale into insignificance when one attempts to compare the results, in the larger aspects, of locations made by untrained men, with those made by locating parties who devote their whole time and thought to location and who become specialists in that class of work. Large reductions in the first cost of construction have been obtained, and better alignment, grades, and drainage have been secured. In the final analysis savings in maintenance and operating costs may well be anticipated from a scientific, economic location.

Location Procedure—The procedure in making surveys is similar to that in railway location—first the reconnaissance, followed by one or more preliminary lines with topography, and contours when necessary; then the projection or paper location, and lastly the final location. All P.C.'s and P.T.'s are carefully referenced by the locating parties, and all field notes are required to be kept in strict accordance with prescribed forms. Careful preliminary cross-sections are taken over the located line at every station and at every important break in the ground. These are merely transverse profiles and are taken by recording the vertical height of each break in the ground at right angles to the center line above or below the ground at the center stake, and the horizontal distance therefrom.

When the survey is finally completed the chief of party plats the profile in pencil on standard sheets 36 x 23 in. to a horizontal scale of one inch to one hundred feet and a vertical scale of one inch to ten feet. On this he lays tentative grade lines representing the subgrade, and he also shows the classification of the materials encountered.

The note books show the suggested size and type of drainage openings required, as determined by special surveys, and other complete information necessary for the proper preparation of plans and estimates. The profile and all of the note books are then sent to the principal locating engineer at Raleigh where they are carefully inspected and then turned over to the drafting department where the final plans are prepared. The alignment, topography, and all other features are platted above the profile to a scale of 100 ft. to the inch.

The preliminary cross-sections are platted on standard-size (36 x 23 in.) sheets and the quantities are computed from planimetered areas of the same. The quantities are then properly balanced by the readjustment of the tentative grade lines. Prints are then made of the project and sent to the District Engineer, who walks over the line, plans in hand, and carefully studies the grades, drainage openings and other features of the survey. He makes such corrections or changes as may seem proper and returns the prints with his approval. The plans and estimate are then completed, the necessary number of blue prints made, and the project is ready to advertise for construction.

A set of prints of a given project consists first of a title sheet, showing the title; index of sheets; a small map of the entire project on a scale of one inch to 1,000 ft.; a small inset map of North Carolina showing the general position of the project with reference to the State as a whole, and a small inset map showing the position of the project with reference to the county and to existing railway and other shipping points.

The next sheet shows the typical cross-section of the roadway, the design of the pavement or surface, ditches, etc.

Then follow the plan-profile sheets showing alignment, grades, clearing, drainage structures, balance points, summary of quantities and other information of interest to a contractor. Next come the cross-section sheets, showing accurate areas and yardages. Then comes a sheet showing the type and design of headwalls, retaining walls or special drawings, and finally come the sheets showing designs in detail of all bridges and culverts, which are prepared in the office of the bridge engineer from special surveys made under his direction. A complete set of plans consists of from 25 to 200 prints bound together.

Costs—The total average cost per mile for making a finished location, as before mentioned, is $92 and the average cost of preparing completed plans and estimates, exclusive of bridge and culvert designs is $25.53 per mile, making a total average cost per mile of completed location, plans and estimates of $117.53 for the entire State. These figures are remarkably low considering the large amount of work involved and the care with which it is performed.

It should be borne in mind that western North Carolina has some of the most rugged mountain country east of the Mississippi and that the eastern section contains many large rivers and almost impenetrable swamps which naturally make for difficult and costly location.

The writer feels that the satisfactory results now being obtained with regard to highway location are due entirely to the highly organized and centralized departments of the State Highway Commission and that without such centralized organization the task of locating and building 5,000 miles of new highways would be many times more difficult and costly.

Cheaper Helium To Help Air Navigation

Lighter-than-air craft have a bright future, in the opinion of Dr. R. B. Moore, chief chemist of the Bureau of Mines, who is in charge of the research work on helium being done jointly by the War and Navy Departments and the Bureau of Mines. The results of experiments in the cryogenic laboratory of the Bureau of Mines lead Dr. Moore to believe that within the next decade 99.9 per cent helium will be produced at a cost as low as $20 per one thousand feet. It is now said that thanks to the perserverance and unselfishness of the Linde company and certain scientists, the problems of helium production have been solved, so that it only remains to reduce the costs of production. Dr. Moore believes that the production cost will be reduced rapidly. Once helium is produced at a moderate cost, he expects to see the lighter-than-air ship take its place as one of the permanent agents of transportation.

Steel and Wrought-Iron Trusses Efficiently Combined in Railway Bridge Reconstruction

Newburyport Bridge in Excellent Condition After 34 Years' Service Increased From E20 to E55 Capacity by Adding Two Steel Trusses in Such Manner as to Develop Full Strength of Both Materials

IN a difficult undertaking of bridge reinforcement, just completed, by which a 34-year-old bridge was strengthened from E20 to about E55 capacity, the engineers of the Boston & Maine R.R. have accomplished the noteworthy result of retaining the old wrought-iron trusses in service and utilizing their full strength in combination with new steel trusses. The ingenious methods by which this result was attained were applied in such manner as to permit of the work being carried on while traffic over the bridge was maintained. Fully as interesting as the reconstruction work, however, is the condition which made it possible, namely that the old structure had remained in almost perfect condition and shows substantially no deterioration through rusting or wear, in spite of the fact that it has for many years been loaded to double its originally intended capacity and, being of pin-connected type, is subject to joint wear.

The old bridge is distinguished by a number of individual features: it is a three-truss structure, with the three trusses built with equal cross-section, though the middle truss received about 50 per cent more load than either outside truss; it is on a skew throughout, from bridge seat to cross-ties, including the swing span; its superstructure was designed by Theodore Cooper in 1887, but the masonry piers date from about 1870, and, though they were thrown out of line in their early years by settlement of the pile substructure under the then single-track pier shafts, they are still good enough to carry the new bridge. For these several reasons the present reconstruction invites careful study.

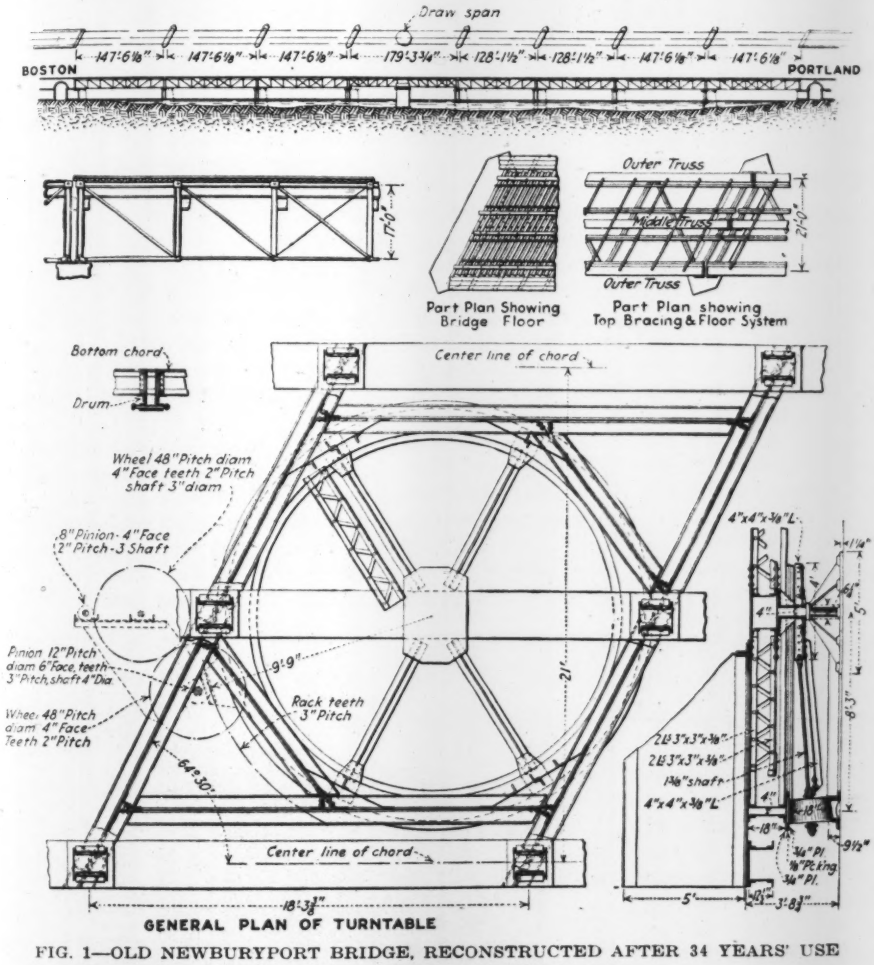


FIG. 1—OLD NEWBURYPORT BRIDGE, RECONSTRUCTED AFTER 34 YEARS' USE

Shown above as it was designed by Theodore Cooper in 1887 and as it was built and was in service until last spring. A peculiar feature of the structure is that the skew extends even to the ties and the draw-supporting girders. The old bridge suffered no measurable deterioration, and in the reconstructed bridge the old metal is being used at full stress value as though new.

The bridge crosses the Merrimac River just north of Newburyport station, 37 miles from Boston. The river is about 1,200 ft. wide and 10 to 20 ft. deep at this point and has a tidal range of 8 to 10 ft. Shipping is accommodated by a swing span at the middle of the crossing and (for smaller vessels) by the clearance under the steelwork, 12½ ft. at mean high water. The latter condition led the War Department to require the same clearance under the swing span for the reconstructed bridge, although a slight decrease of clearance was allowed in the fixed spans.

Reference to the drawing Fig. 1, reproduced from the original design sheets, will show the general character of the old structure and its principal dimensions. Five of the seven fixed spans are 147 ft. 6⅞ in. long, the other two 128 ft. 1½ in., and the draw span 179 ft. 3¾ in. A sketch of the draw-span turntable is included. In the fixed spans, as will be seen from the drawing, the top lateral system extended between outside trusses only, there was no stringer bracing, and the three top chords and four lines of stringers were tied together by single-angle transverse struts spaced about 7 ft. apart. In the draw span the supporting girder system comprised two main

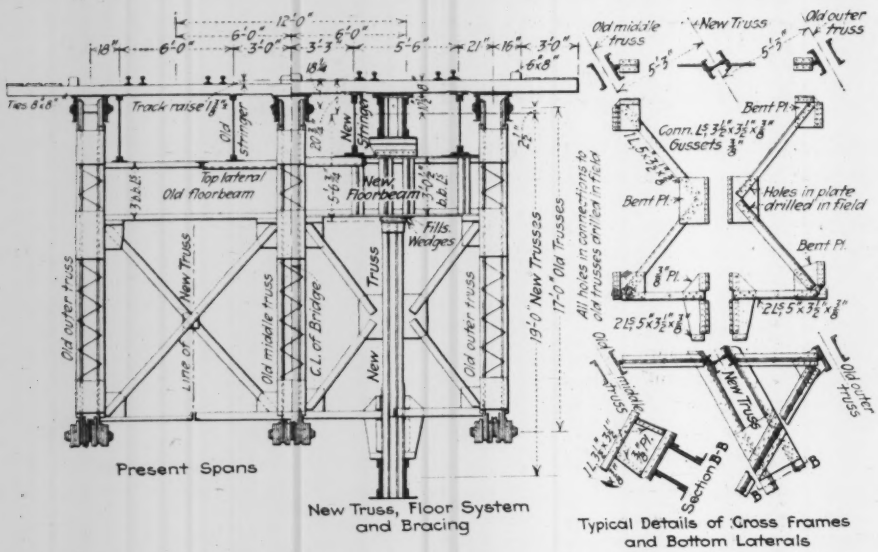


FIG. 2—TWO NEW STEEL TRUSSES ADDED TO THREE OLD WROUGHT-IRON TRUSSES
Floor system and bracing renewed. New trusses made 2 ft. deeper than old, to take greater stress at equal deflection.

transverse girders on the same skew as the other parts of the bridge, and two longitudinal distributing girders, which, together with two short diagonal girders in the sharp angles of the resulting parallelogram, brought the load of the span to bear on the drum at six points. The main transverse girders, however, were thus supported eccentrically and tended to deflect unequally with a resulting tendency for the girder parallelogram to droop at the ends of its long axis and twist the connections of the girder system. While this condition had not given rise to noticeable difficulty in the operation of the old bridge, it required to be dealt with in the design of the reinforcing work in order to secure reasonably uniform distribution of the greatly increased load.

In the detail of the turntable it may be noticed also that the drum was very shallow and that the tread by which the drum rested on the wheels was carried by a pair of wide plates separated ⅛ in. by packing along the edges. This construction apparently had the object of producing a cushioned support for the tread, and as the drum and wheels withstood their long service without damage it was evidently effective. The bottom chord of the middle truss cut through the drum girder, but the latter was spliced across the chord by reinforcement material and top-flange cover plates. Of the whole turntable structure, no part suffered any material damage or gave rise to trouble in the history of the bridge, except that the circular track did not bear evenly or maintain good surface. It should be remarked further that the entire draw span was several inches off line and slightly out of level during the larger part of its existence as the result of settlement of one side of the pier. The pile substructure was constructed for the double-track width at the very start, about 1870, but the pier masonry above low water was carried up only as single-track shafts; when the original wooden single-track superstructure was replaced by the wrought-iron Cooper bridge in 1888, the remainder of piers was built up, but even long after this time the actual traffic over the bridge was single-track, as the connections for the second track were not completed. Tilting of the piers upstream and lateral shift of the draw pier developed at an early stage, the movement being in the direction of the first track. The maximum difference of settlement between one side and the other was about 1½ in.

Reinforcement or Replacement—Computed with proper allowance for impact, the old structure had a carrying capacity equivalent to about E20 to E22, more accurately E20 to E22 for the center truss and E28 to E30 for the outer truss and the floor. Traffic over the line has for years had a maximum load equivalent of E40 to E45, but for some time past trains have not been allowed to meet on the bridge on account of the lightness of the middle truss. The bridge thus was overloaded and developed considerable vibration. Accordingly, it was kept under very careful observation, without, however, showing any local weaknesses.

Replacement or reinforcement has been in contemplation for four or five years, but because of financial and other conditions the work could not be taken in hand until last year. At that time, on full study of the various conditions governing the work, it was decided to reinforce the old bridge rather than to build a new bridge.

Preliminary to this decision, careful review of the condition of the old masonry led to the conclusion that it is adequate for the necessary increased superstructure weight and present traffic load for some time to come. The limited width of the piers would not, however, permit of supporting new trusses outside the old ones, unless distributing girders were put in on

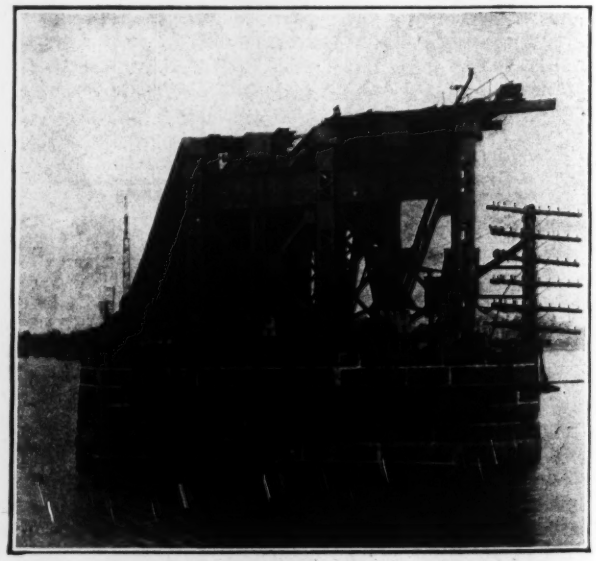


FIG. 3—FIVE TRUSSES OF RECONSTRUCTED BRIDGE
The two intermediate trusses are steel, the original ones wrought iron.

the piers, and these, under the circumstances, would be so costly and difficult to install as to put them out of consideration.

The number of piles in the pier footings could be determined approximately, and on the basis of the resulting estimate of their carrying capacity, taken in connection with the fact that the piers had become stabilized and under double-track operation, they were considered ample for present loads. Therefore, nothing more was done than to point and grout the masonry thoroughly. In the reconstructed bridge the load will be distributed over the piers more uniformly than in the old bridge, especially with one track loaded, which is a favoring factor. However, if later on the piers should develop weakness under increased loading they can be strengthened or rebuilt, as required, fully as cheaply as (under traffic) at present.

Study of the factors affecting the superstructure included the following points: The wrought iron of the old bridge was in excellent condition, showing no rust deterioration (the bridge had been kept well painted) and no pin wear; the bridge would have to be kept open for traffic during reconstruction, as a run-around line was not practicable; no additional dead-load could be put upon the old bridge while it was carrying live-load, in view of the existing high overstress; building a new structure around the old one involved serious complications and high cost in view of the need for pier girders to carry it safely on the old masonry; falsework construction would be costly, and in the draw span would not be practicable in any event. New spans might be floated in; but regardless of questions of cost and difficulty it was apparent that new superstructure would require additional metal over a reinforcement scheme, corresponding to the value of the old metal utilized in the latter. Because of these several conditions, when a satisfactory reinforcement scheme had been evolved, it was preferred in every point to the most attractive replacement scheme. At least $100,000 or about 25 per cent of the cost of a new structure was saved by reinforcement.

Reinforcement Scheme—The cross-section in Fig. 2 most simply explains the method of reinforcement. The half width of the old bridge is shown at the left and the half width of the reinforced bridge at the right. It will be seen that two new trusses are added, one between either outside truss and the center truss, together with new stringers, floorbeams and bracing. In the fixed spans the new trusses are 19 ft. deep between chord centers, as compared with 17 ft. for the old trusses.

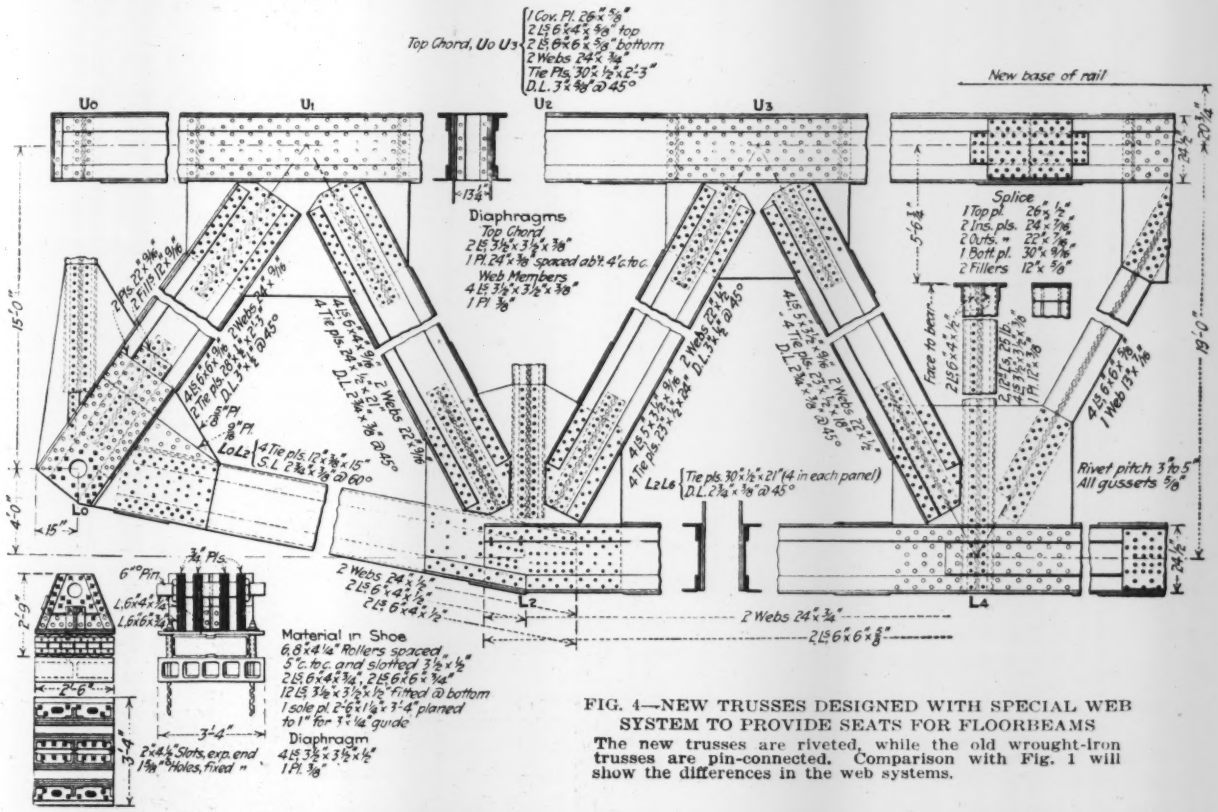


FIG. 4—NEW TRUSSES DESIGNED WITH SPECIAL WEB SYSTEM TO PROVIDE SEATS FOR FLOORBEAMS

The new trusses are riveted, while the old wrought-iron trusses are pin-connected. Comparison with Fig. 1 will show the differences in the web systems.

The basic principle of the reinforcement scheme is that the deep floorbeam connections and rigid cross-frames, whose details are shown at the right in Fig. 2, make the entire assemblage of five trusses a unit as regards deflection, so that any load will develop stresses in the different trusses proportionate to their depth. The chords of the old trusses, therefore, will be stressed about 10 per cent less than the new trusses, which difference was considered to correspond roughly to the difference in allowable working stress between steel and wrought iron. It followed that the total strength to be provided in the new trusses was the difference between the total load and the amount of load which would be carried by the three old trusses at a unit stress of 13,500 lb. per square inch, this remaining load being assigned to the two new trusses at a unit stress of 15,000 lb. per square inch. The same relation

between stresses in the two metals was maintained throughout, compressive stresses being suitably reduced for column effect.

In this scheme it was necessary to discard the floor members and the bracing, partly because these had to be remodeled in any event to admit the new steel and partly because the floor members were inadequate for present-day loads in spite of the fact that they had been strengthened some years ago by fitting stiffeners to the floorbeam webs and repairing the top flange angles under the stringers, where the riveting had been injured and the flange angles broken by the concentrated loads from the stringers. Thus the bridge retains the three old trusses and the single-angle stringer braces, discarding all other parts of the superstructure.

As the action of the reinforced structure depends essentially on the stiffness of the transverse connections, it is of value to record that when the reinforcement had been completed for one-half of the bridge, but no work done on the other half, producing a condition corresponding to that shown in the cross-section in Fig. 2, the bridge was free from vibration when a train moved over the track on the unreconstructed side, and no difference of deflection of the four trusses could be noticed, indicating that even the half-completed work was able to assure equal deflection and proper load distribution.

The entire reconstruction carried out according to this scheme involved a weight of new steel amounting to 4,758,000 lb. The character of the new portions of the bridge is indicated by Fig. 4, a drawing of one of the 147-ft. 6½-in. fixed spans. The truss work of the draw span is generally similar, but the new trusses (see Fig. 5) had to be kept down to the same depth as the old, 15 ft. in this span, and in addition the depth over the turntable had to be contracted to about 12 ft. by carrying the bottom chord upward, so that it could pass over the drum and continue through the web of the new longitudinal girders placed on the lines of the trusses.

Considerable complication was involved in devising suitable reinforcement at and over the turntable. The character of the old distributing girder system made it necessary that the reinforced girder system should be extremely rigid, in order to distribute the load effectively over the shallow drum. A deeper drum could not have been provided without costly and difficult work in cutting down the pier masonry.

The drawing Fig. 5 shows the reconstructed girder system over the drum. The main transverse girders were retained unchanged, but the longitudinal distributing girders were removed and two new ones on either side were substituted. As the overhang of the outer trusses beyond the outer distributing girders is the same as before, the moments in the transverse girders are not increased, and the additional load of the two new trusses is transferred to the drum directly through the new longitudinal girders, which take their reactions from the trusses as shown in the longitudinal section in Fig. 5. In order to distribute this load over the drum, three subsidiary girders were introduced in each half of the girder parallelogram, giving twelve bearing points on the drum in place of the original six. At the same time the drum was fitted with stiffeners on both inner and outer webs, there having been no stiffeners

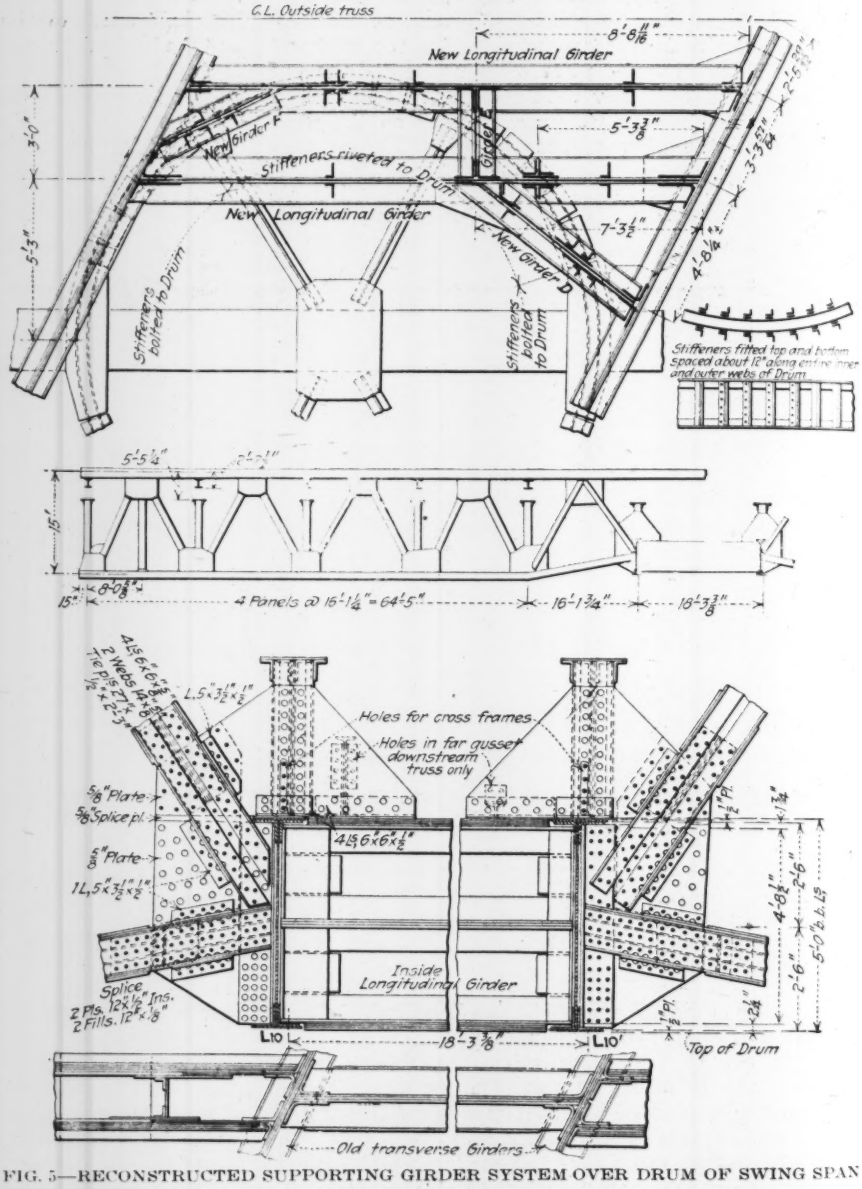

C.L. Outside truss
New Longitudinal Girder
New Girder
Stiffeners riveted to Drum
New Longitudinal Girder
New Girder D
Stiffeners bolted to Drum
Stiffeners bolted to Drum
Stiffeners fitted top and bottom spaced about 12" along entire inner and outer webs of Drum
4 Panels @ 16'-1¼" = 64'-5"
Holes for cross frames
Holes in far gusset downstream truss only
Inside Longitudinal Girder
Splice 2 Pls. 12½"x ins. 2 Fills. 12"x ⅜"
L10
L10'
Top of Drum
Old transverse Girders

FIG. 5—RECONSTRUCTED SUPPORTING GIRDER SYSTEM OVER DRUM OF SWING SPAN

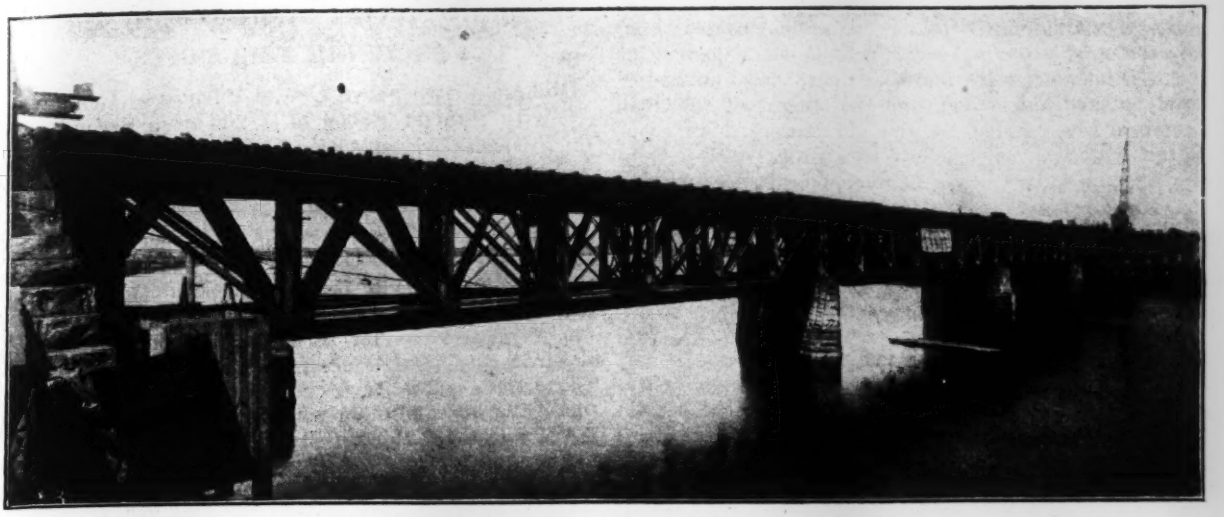


FIG. 6—CONTRAST OF OLD AND NEW TRUSSES AFTER RECONSTRUCTION OF EASTBOUND TRACK

originally. As may be seen from the longitudinal section, the bottom chords of the new trusses are carried through the distributing girders by longitudinal angles riveted to the webs of these girders.

In connection with these changes, eyebar diagonals have been put in the middle panels of the old trusses, which originally had no diagonal in the center panel, in order to avoid transmitting any shear across the turntable. Complete new machinery has also been installed, as well as a new track, while the upper tread and the body of the drum remained unchanged.

Construction Work—Two methods of carrying out the reinforcement were considered. In one it was contemplated to place first the new floorbeams, by the process of taking out one floorbeam and inserting the new one, following with the new stringers, and so progressing from panel to panel, then setting in place the top chord of the new truss in that half, and thereafter attaching the web members and bottom chord to complete the truss. The work was to be done first on one track width, then on the other, leaving one track for traffic at all times. The other plan contemplated suspending transverse stirrup beams at each panel point below the bottom chord, these beams spanning a single-track half (from center truss to one outside truss), then laying the new bottom chord on these beams, and building up the web members of the new trusses; inserting the new floorbeams in place of the old, seated on the new truss posts; and finally placing the top chord and connecting up all members of the new truss. Neither method required additional supports. The contractor elected to use the second method, supporting the new trusses at the bottom chord.

Work has proceeded very rapidly, reaching such a rate of speed as the erection crews became skilled in the details of the work that finally, in one of the 125-ft. fixed spans, the complete reconstruction of the first single-track half was carried out in 2½ days.

In the actual arrangement of the work two erection crews were used, one starting at either end of the draw span and working backward (to avoid running the cranes over the new work during construction). The eastbound track was closed to traffic and all trains were routed over the westbound track. Beginning at the ends of the draw the erectors, using a locomotive crane, took out the stringers and floorbeams and top lateral bracing of two panels, substituting crossed cable diagonals for the lateral system where interrupted by this process. The section of new bottom chord was then set in place on the stirrup beams suspended below the panel points by threaded rods attached to yokes laid over the top chords; the truss posts were next set up, and the sway frames, floorbeams, stringers and top chord were placed. When the floorbeams were being set, wedges were inserted between truss posts and floorbeams for subsequent adjustment of the span.

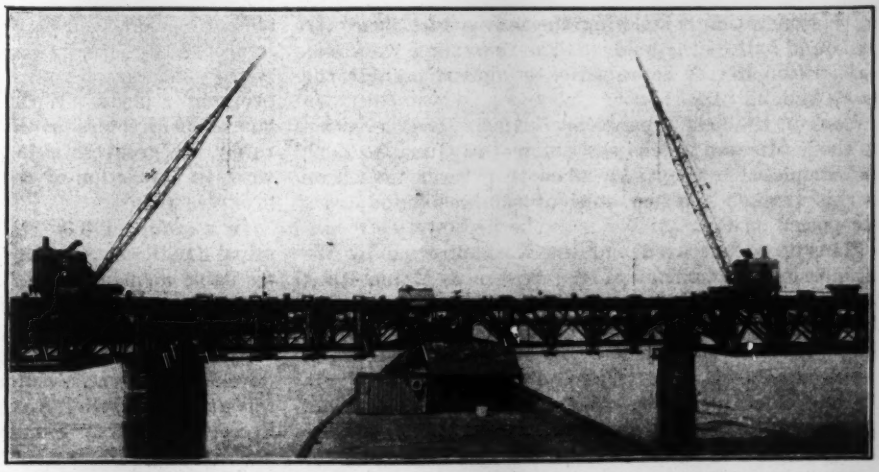


FIG. 7—LOCOMOTIVE CRANES COMPLETING ERECTION OF DRAW-SPAN TRUSSES

This process continued backward across the span, two panels at a time, until the new truss and bracing for the eastbound track were complete in that span. Up to this point no riveting had been done, the joints being merely pinned and bolted, and the weight of the new steelwork was carried by the old trusses. As soon as the span was swung, riveting began. When this was completed the wedges between floorbeams and the new truss posts were driven to a tight bearing with 15-lb. mauls. The connections for the sway bracing were left blank, and were drilled and riveted only after all the other work was completed, to avoid putting any initial stress into the sway bracing.

The erection crew meanwhile was proceeding in the next span. Both crews reached the abutments about the same time. In proceeding with the draw span they had to take care to work closely in unison, so that the draw would be balanced at all times. Navigation required that the draw should be maintained in operating condition, and as the reconstruction of the distributing girder system and machinery required the removal of the old machinery it was necessary to rig up an operating rope attached to the outer end of the fender pier by which one of the cranes could swing the draw open or shut at any time upon signal from a vessel.

Work In Draw Span—Reconstruction of the distributing girder system was the first item of the draw span work. The new longitudinal girders (on the line of the new trusses) being inserted first, the old longitudinal girders could be taken out, the new ones immediately inserted, and the subsidiary girders built into place.

In preparation for this work the entire draw span had been leveled up (the pier having tilted years ago) and moved eastward several inches into proper alignment with the fixed spans, and the new track segments placed. This work was done while the draw was closed to navigation for a 6-day period, when it was possible to jack up from the piers. River traffic was interrupted on only one other occasion, a four-day period when the end wedges and operating machinery were being changed and adjusted.

After reconstruction of the turntable girder system and attachment of the stiffeners to the drums, the erection of the new truss on the eastbound side went on, this operation completing the reconstruction of the eastbound half of the bridge. The remaining work was a repetition of the same series of operations for the westbound half.

Work in the field began May 5, 1922. Steel erection on the eastbound track was started on June 8, 1922, and completed by Sept. 11, when traffic was turned on to this track. The last steel of the westbound track was placed on Oct. 22.

Plans were prepared and the work directed by the engineering department of the Boston & Maine R.R.; A. B. Corthell, chief engineer; F. C. Shepherd, assistant chief engineer; B. W. Guppy, engineer of bridges; F. D. Hall, electrical engineer; G. L. Huckins, construction engineer; Pusey Jones, chief draftsman, and W. D. Thorne, chief inspector. The Shoemaker-Satterthwait Bridge Co., of Pottstown, Pa., was contractor for the fabrication and erection, as well as for dismantling the old structure, placing ties and painting. The contract totaled $230,000.

Simple Aerial Photography for Practising Engineers

Oblique Views Serve Useful Purposes—Camera with Shutter Speed of 1/200 of a Second Needed—Best Altitudes 500 to 1,500 Ft.

By Fred H. Tibbetts
Consulting Engineer, San Francisco, Calif.

SO MUCH has been written about aerial mapping that the uses of simpler airscapes in engineering work are in danger of being overlooked. Aerial photographs for engineering work are of two general types: (1) Vertical views for aerial maps; and (2) oblique or bird's-eye views as descriptive and illustrative aids. The oblique views have been employed frequently by the writer in connection with engineering work and it is the purpose of this article to interest other engineers in their use.

Aerial photographs of the first general type are taken with the camera pointed vertically downward and generally from considerable elevations, say 10,000 to 12,500 ft. They have been used extensively in the construction of mosaic maps for military purposes. Very recently the making of such maps has been developed to a very high degree. Descriptions of methods and results on the Tennessee River surveys, which are typical of the latest improvements in aerial mapping, were published in *Engineering News-Record*, Oct. 5, 1922, p. 552, nd also in a paper read before the American Society of Civil Engineers on Oct. 4, 1922.

Aerial mapping of this precise sort is a development of the photographic art of great importance to the engineering profession, and the writer urges that engineers consider it whenever it can be applied economically in their work. However, because aerial mapping must be done with special and costly precise apparatus not commonly available in this country except through cooperation with military authorities, it is generally too expensive for any but very large and important projects.

Bird's-Eye Views—Oblique views, on the other hand, should be used by engineers more extensively than at present because such views can be taken by any amateur with ordinary commercial apparatus. These views are of great value in illustrating preliminary reports and they enable other engineers, and particularly non-technical men who have not seen the ground to be improved, to visualize projects rapidly and accurately. Aerial photographs are also of value for illustrating progress reports. With such views it is possible for boards of directors or other executives to appraise accurately the progress that is being made on construction work in a fraction of the time required to read over a progress report.

In a study of city traffic problems, fire hazard, terminal facilities, etc., any practising engineer with any available airplane can in a few minutes, from a height of a thousand feet, obtain photographs from which can be counted automobiles or other units of vehicular traffic, freight cars, boats or buildings. For land development work oblique aerial photographs show topography in relief, a result not satisfactorily obtained by vertical views. Simple photographs of this sort also show clearly the extent of forests, the position and extent of water courses and other topographical features.

An instance of the application of oblique views in awarding clearing contracts and in developing natural drainage channels appeared in *Engineering News-Record*, Nov. 23, 1922, p. 889.

Good oblique aerial photographs can be taken with any ordinary hand camera fitted with a shutter which will work with a speed at least as rapid as 1/200 of a second. Under average conditions of good light 1/300 of a second is better, and with this timing an aperture of from F 5.6 to F 8 will ordinarily give fully-timed negatives. Care should always be used to hold the camera free from direct contact with any portion of the airplane, otherwise vibrations of the machine are transmitted to the camera, with a corresponding loss in sharpness of the negatives. A camera with a focal plane shutter, such as a Graphic or Graflex, will probably give better results and a sharper negative than one with the more common, between-lens, shutter. The writer believes that a Graphic will give just as good results as the more bulky and unwieldy Graflex camera, as the hooded focusing device and reflex feature of the Graflex is practically useless in the air. The camera can be sighted with sufficient accuracy by looking along one corner of the box toward the center of the object desired in the picture, though a rectangular direct-view finder is of advantage in showing the extent of the territory which will be covered.

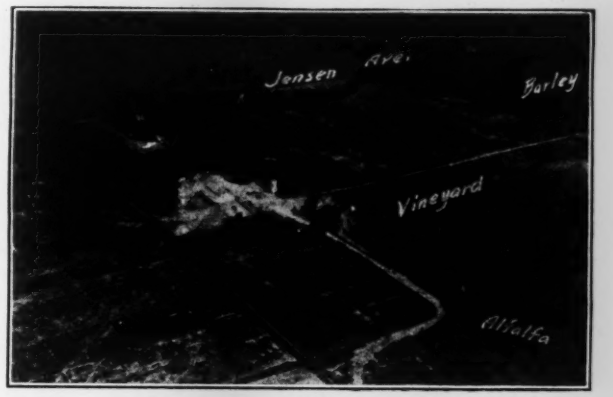
Ray filters will seldom improve results, even on a hazy day. The lightest ray filter in ordinary commercial use requires about three times the normal exposure, and under light conditions which would indicate the use of a ray filter for ground work an ordinary lens would be nearly wide open with a 1/200-sec. exposure without the ray filter. To use a filter and give sufficient

CONDITIONS IN NEVADA IRRIGATION DISTRICT

Shows extent of orchard development in area previously heavily wooded. Note relative amounts of clearing required in foreground areas. Photo made on graphlex plates at an altitude of 1,100 ft., 8:30 a.m., Sept. 21, 1921. Exposure 1/200 second, F-5.4 aperture.

time under these conditions would require lengthening the exposure to a point which would preclude clear negatives. Plates probably give better results, though more difficult to use, than films—quite likely because they are less sensitive to the vibrations of the machine. Plate-holder attachments are on the market which permit the use of twelve plates which can be readily changed in the air.

In the more common types of airplanes the engineer or photographer will have one cockpit to himself, with his view more or less obstructed by the wings or tail of the machine. The best photographs will be secured if an aviator can be found who has already had experience in this kind of work, or who can be carefully instructed in advance to maneuver his machine for each photograph so that the object to be photographed can



VIEW TAKEN TO ACCOMPANY SEWAGE FARM REPORT

Main irrigation ditches for sewage distribution in center foreground. Note laterals and checks in alfalfa field at right. Taken with graphic camera at an altitude of 800 ft. at 11 a.m., May 6, 1922. Exposure 1/200 second, F-8 aperture.

be taken with the camera pointed diagonally away from the machine, about half way between the wings and the tail. The photographs should be snapped when the machine is moving straight ahead, as clearer views will thus be obtained than if the machine is turning.

Because of the noise of the motor communication in the air between photographer and pilot is usually by signs or written notes. The photographer can indicate by pointing the object which he wishes to take, and the aviator should then bring his machine into proper position. There should be no hesitancy in signaling the pilot to return and repeat the maneuver, if the photographer is not satisfied that he has secured a good view.

As in any photographic work, the views should be obtained looking in the direction of the light. The best results can ordinarily be obtained from an altitude of about 1,000 ft. The limits for such views, if much detail is desired, are probably between 500 and 1,500 ft. A careful aviator is often reluctant to fly at these low elevations, and ample time should be allowed to get the machine thoroughly warmed up and running satisfactorily before starting such a flight.

If the topography is broken and landing fields are few there may be some element of risk in flying so low, and in mountainous country the risk certainly becomes too great to permit of flying at low elevations. The worst conditions will obtain over rugged, and particularly bare, mountain-peaks on a warm summer afternoon when vertical, eddying and irregular air currents will ordinarily necessitate flights from 2,000 to 5,000 ft. above the ground surface. Even under these conditions, however, excellent general views can be obtained of mountain topography for water supply, railroad, highway, or other developments. Quieter air and lower safe altitudes will almost invariably be found in the first half of the morning than later in the day.

The direct benefits to the practising engineer of using an airplane for reconnaissance should not be overlooked. Most engineers have had experience with the use of the camera, and when oblique aerial photo-

graphs are to be made under their direction they can just as well take the photographs themselves. Not only is the engineer the best judge of the subjects which he wishes to photograph, but by making the flight himself he gets the benefit of direct inspection and study of the territory in which the work is projected or under way. Where the chief or locating engineer desires a comprehensive, general, first-hand idea of a mountainous watershed, for example, its topography, improvements, forest covering, etc., he can frequently obtain more information in a few hours in an airplane than he could in as many weeks of laborious and costly ground travel.

As to the costs for the services of airplane and pilot, the commercial rate on the Pacific Coast is $50 per hour for a plane carrying pilot and two passengers and capable of making 50 to 60 miles per hour (the slower the speed the better for photographic purposes). On a recent piece of work in which a plane was used at this rate for a total of four hours in the air, sixty exposures were made from which were selected twenty photographs suitable for the purposes in hand.

Design of Storm Sewer and Flood Gate, Wichita Falls, Tex.

By Julian Montgomery
Of Montgomery & Ward, Consulting Civil Engineers, Wichita Falls, Tex.

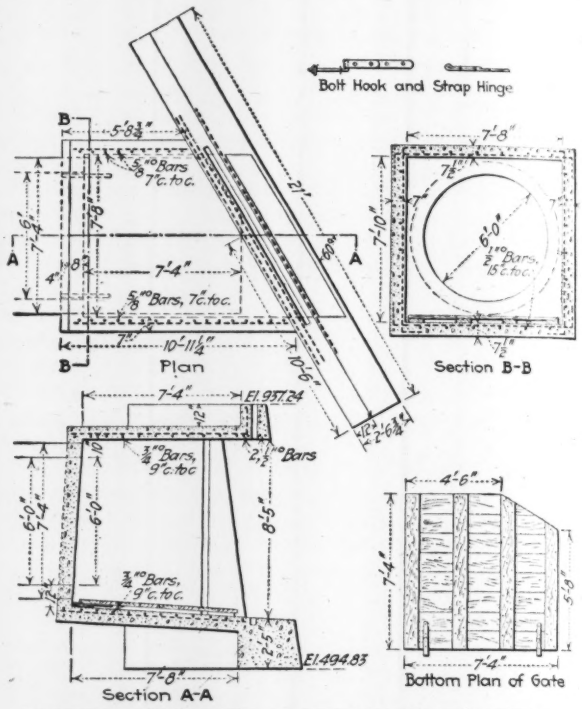
INCLUDED in the construction program launched by Wichita Falls two years ago was a storm sewer for the central residence and adjacent business district. Previous to this project none of the residence districts contained storm sewers, and only a part of the business district. On paved streets the storm water was carried by surface drainage, and as the business district is considerably lower than most of the residence districts the sudden downpours common to this part of Texas often flooded the business district. The two storm sewer mains, with their laterals, known as the Indian St. and Austin St. storm sewer systems, were designed to carry off the flood water from the business district and to relieve the more thickly populated central residence district, part of which is paved, but the major portion of which is yet unpaved.

In making the design, local conditions were carefully studied. Ordinarily, the climate at Wichita Falls is a dry one. When it does rain, sudden downpours, often of considerable quantity, are not uncommon. The storm sewers were designed for a rainfall of 2 in. per hour, using a runoff coefficient of 0.6 for the residence district and 0.7 for the adjacent business district, which district is on the edge of the main business part of the city. The rational method of design was used. A topographical map of the city had only recently been completed and it was used for obtaining the drainage areas tributary to the two systems.

After receiving bids on brick, concrete and segmental blocks, the latter type was chosen as being considerably the cheapest. The sewer was 72 in. in diameter on one street and 84 in. on another.

Flood Gate—A feature of the outfall design is the flood gate and chamber. During flood stages of the Big Wichita River, the river water, unless prevented, will back into the storm sewers, and occasionally will get high enough to come out through the inlets. Since the river water is very muddy, a considerable amount of mud and sand will be deposited in the sewers unless the water is kept out. The drawing shows a design for a flood gate which has proven very successful.

The gate, which is built of red cedar, is hinged at the bottom. The reinforced-concrete gate chamber is so built that ordinary flow through the sewer will pass under the gate and prevent a possible deposit of sand or silt on it to weigh it down and keep it from floating. As the river rises the top of the gate floats. When the water gets up within about two-thirds of the top of the sewer the gate will shut. The vertical face of the



SEWER FLOOD GATE AT WICHITA FALLS, TEXAS

chamber, or sewer, which the gate shuts against, is inclined toward the river, so that the gate closes the sewer before it comes entirely to a vertical position, thus obtaining a certain amount of additional pressure in holding it shut. In constructing the concrete gate chamber the gate itself was used as a form for the back face, so that it would fit exactly when it was shut.

The storm sewer was designed by F. M. Rugeley, office engineer, City Engineering Department, under the supervision of the writer, who was at that time city engineer. R. C. Thaxton and John A. Donald were resident engineers in charge of construction. The contractor was C. H. Foley of Wichita Falls.

Soil Gas Leakage Through Basin Floor

Failures in the floor of the reflecting pool in front of the Lincoln Memorial at Washington recently led to an investigation by the Bureau of Standards to determine their cause. Bubbles of gas had been observed rising in the pool. It was found that these bubbles consisted of methane and carbon dioxide, that they came through the floor from the ground beneath, and that they probably resulted from decomposition of buried organic matter in the soil. No means of preventing the gas formation were suggested but it was recommended that vents be provided for the gas to escape without passing through and damaging the basin floor.

Porto Rican Concrete Arch Bridge Has Novel Spandrels

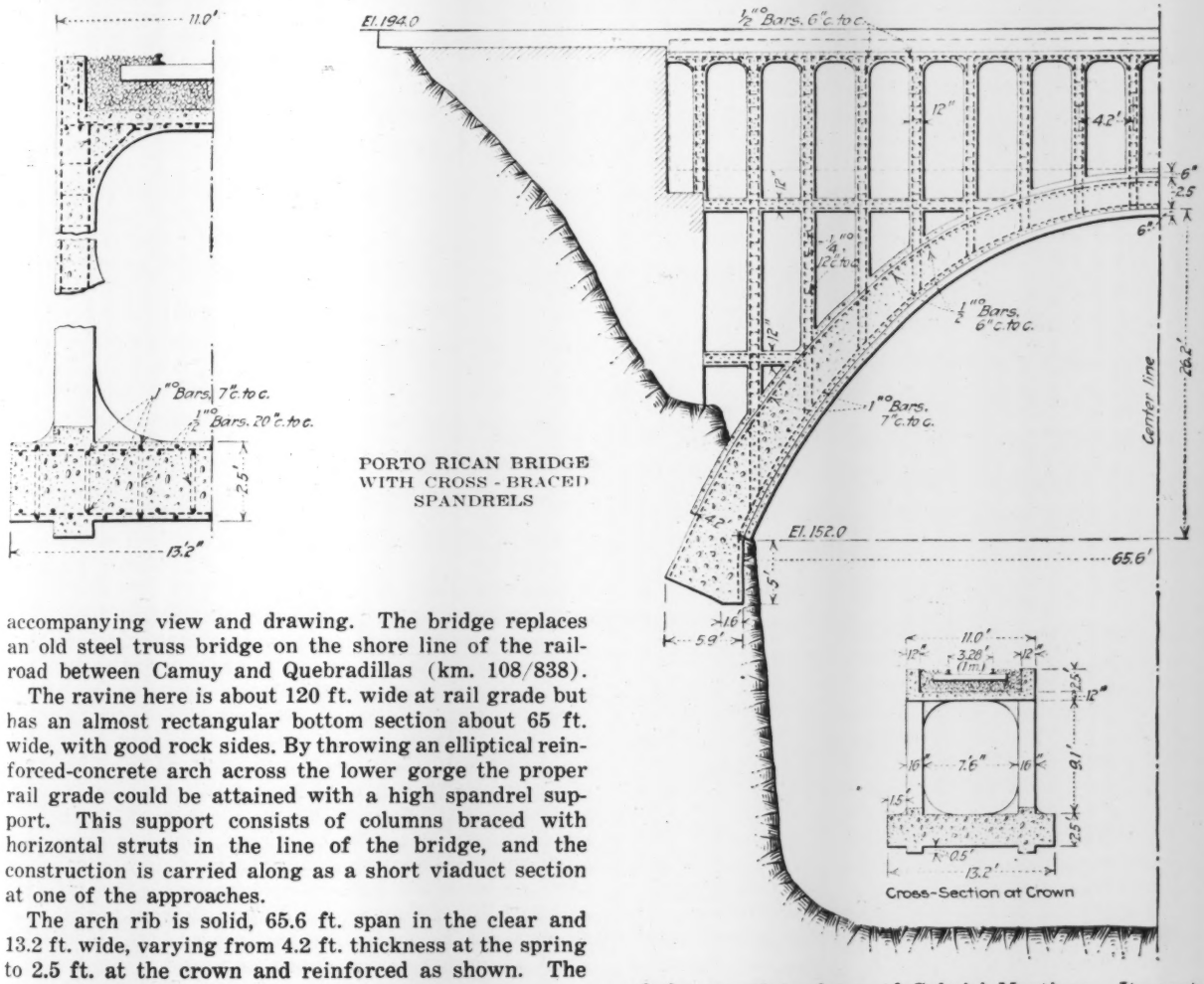
Roadway of Railway Bridge Near Seashore Is Carried on Slab Supported by Gridiron Shaped Posts and Braces

A DEEP gorge crossing on the American Railroad of Porto Rico has been solved by the use of the novel type of spandrel concrete arch shown in the accompanying view and drawing. The bridge replaces an old steel truss bridge on the shore line of the railroad between Camuy and Quebradillas (km. 108/838).

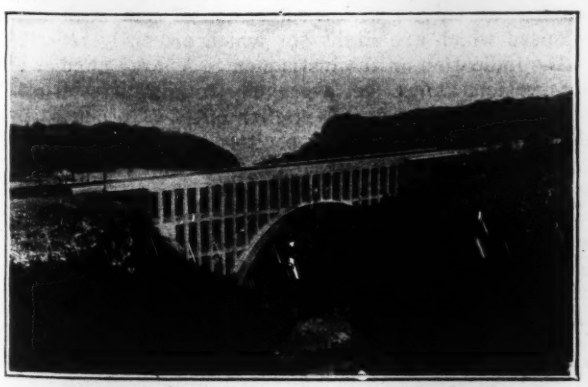
The ravine here is about 120 ft. wide at rail grade but has an almost rectangular bottom section about 65 ft. wide, with good rock sides. By throwing an elliptical reinforced-concrete arch across the lower gorge the proper rail grade could be attained with a high spandrel support. This support consists of columns braced with horizontal struts in the line of the bridge, and the construction is carried along as a short viaduct section at one of the approaches.

The arch rib is solid, 65.6 ft. span in the clear and 13.2 ft. wide, varying from 4.2 ft. thickness at the spring to 2.5 ft. at the crown and reinforced as shown. The floor is dropped slab 12 in. thick with sidewalls to retain the ballast in which are placed the ties for the meter-gage track. The spandrel columns, 12 x 16 in. in section, are reinforced with straight rods, and braced by the cross struts with curved knees. In the line of the posts the arch is increased in thickness by 6-in. extensions above and below. The heaviest locomotives on the line weigh 84 tons.

The bridge was designed by Etienne Totti, chief engineer of the railroad, and was built under his direction and the superintendence of Gabriel Martinez. Its cost is stated as $18,000.



PORTO RICAN BRIDGE WITH CROSS-BRACED SPANDRELS



CONCRETE BRIDGE ON AMERICAN R.R. OF PORTO RICO

Further Appropriation for Transandine Ry.

An increase of 1,500,000 gold pesos is proposed in a law recently submitted to the Argentine Congress, to be used for the electrification of the Argentine Transandine Ry., 45 km. long, between Zanjon and the Chilean frontier. A contract between the government and the Argentine Transandine Ry. Co., already approved, provides for joint administration of the Chilean and Argentine transandine roads connecting Mendoza and Los Andes and stipulates that the government shall place at the disposition of the railway company bonds of the Argentine external loan, not to exceed 2,500,000 gold pesos, bearing 5 per cent interest, with 1 per cent amortization.

Motor Truck Tractive Resistances on Road Surfaces

Elimination Tests of Measuring Devices Prove Superiority of Space-Time Recorders—Gasoline Consumption Measured in Relation to Tractive Resistance

By T. R. Agg
Professor of Highway Engineering, Iowa State College, Ames, Iowa

AN INVESTIGATION of the economics of highway grades was begun in 1919 at the Iowa Engineering Experiment Station. Before the work had been under way very long it became apparent that correct values for tractive resistance would be needed to establish the theory of highway grades. An investigation of the subject of tractive resistance was therefore inaugurated at Ames and later developed into a co-operative project, with the Bureau of Public Roads and the Iowa Highway Commission participating. The work is now well along toward completion and is under the supervision of A. T. Goldbeck, of the Bureau of Public Roads, and the writer.

Equipment—Through the co-operation of F. R. White, chief engineer, Iowa Highway Commission, trucks, tires and much minor equipment were supplied by the Commission. The types and the characteristics of the several vehicles employed are indicated in Table I.

Dynamometer Measurements Unsatisfactory—The Davidson dynamometer was used for the first measurements of tractive resistance. This dynamometer is placed between the truck under test and a towing truck and is designed to record the drawbar pull for a comparatively short distance, usually either 50 or 100 ft. It is a spring-dynamometer with a recording device that plats a curve of draw-bar pull and mechanically integrates the area between the curve and the zero line.

From the beginning, difficulty was experienced in securing concordant results with this method. The dynamometer operated nicely but the towed vehicle surged considerably, due to the slight unevenness of the road surface. This surging introduced impact errors which are clearly indicated by the curve of draw-bar pull in Fig. 2. In addition to these effects, difficulty was experienced in maintaining uniform vehicle velocity. Undoubtedly many of the records were affected by acceleration as well as by impact.

It was thought that if the records were made by towing the truck up grade, most of the impact effects would be eliminated. This did not prove to be the case, although records so taken are much less erratic than those taken on level roads.

In Table II there are given some values of tractive resistance obtained with the Davidson dynamometer. Later investigations show these values to be somewhat high, and they are chiefly of interest because they indicate the wide variation in individual determinations. No method was discovered for eliminating these objectionable characteristics of the dynamometer determinations, although other types of dynamometer were tried; it was therefore necessary to seek some other method of measurement.

Accelerometers Difficult to Read—There are several instruments in use that are intended to indicate, or record, tractive resistance by the acceleration method. The Wimperis accelerometer was developed by H. E. Wimperis, Hampstead, England, and is manufactured by Elliott Bros. Co., Ltd., London. In principle the instrument consists of an unbalanced disc mounted horizontally, with a spring for resisting rotation and for returning it to the zero position. The instrument is mounted on the vehicle and by means of the leveling screw the pointer is brought to the zero position when the vehicle is standing on a truly level place. Any acceleration or deceleration of the vehicle causes the disc to rotate and moves the pointer to the proper scale indication. The instrument is calibrated to show tractive resistance in pounds per ton.

CONCLUSIONS EPITOMIZED

1. About half the fuel consumed by a motor car or truck is required to operate the mechanism and to overcome air resistance.

2. Unevenness of surface is immediately reflected in an increase in tractive resistance.

3. A change to a better type of surface may easily save enough fuel to liquidate the cost of the improvement.

4. Bituminous type roads show materially higher resistance in hot weather than in cold.

5. Rolling resistance on low-grade roads is an exceedingly variable quantity.

In determining tractive resistance with this instrument, the vehicle was driven at speed to the beginning of the section of road upon which tractive resistance was to be determined, and then declutched and allowed to coast to rest, or was allowed to coast from rest down a hill. Simultaneous readings of the accelerometer and of speed were taken as rapidly as the observer was able to do so. An accurate and sensitive speed indicator must be used as the ordinary speedometer is not sufficiently accurate for the purpose.

It was found that certain difficulties were likely to be encountered in using the instrument. One was the effect of uneven road surfaces on acceleration or deceleration. The vehicle does not change speed uniformly but instead travels with a succession of erratic changes in speed which are slight but which are truly reflected in the indication on the instrument. A large number of observations must be averaged to eliminate erratic points on the curves. A similar effect is produced by the change in the relative position of the body of the vehicle and the wheels, resulting from the spring action, and this is a serious matter at high speed.

Another difficulty was that of reading the instrument. The graduations on the dial are fairly close together and it is exceedingly difficult to read the value of acceleration or deceleration, particularly when the instrument is being used on trucks.

It is believed that this instrument would be satisfactory for measuring car performance but for the small values of deceleration obtained in measuring tractive resistance it was impossible to read the scale

TABLE I. VEHICLES EMPLOYED IN TRACTIVE RESISTANCE INVESTIGATIONS

Vehicle	Gross Weight, Tons	Size and Type of Tires	Remarks
Buick 21-45 Touring Car	1.85	33 x 4 U. S. Royal Cord, inflation 65 to 70 lb. per sq.in.	Weight includes driver and observer. Car and tires nearly new at beginning of series of runs.
Light Aviation Army Truck	4.14	Front 35 x 5 Goodyear Cords, all weather tread; rear, twin 35 x 5 Goodyear Cords, all weather tread; inflation 85-90 lb. per sq.in.	Truck and all equipment new at beginning of the series of runs.
Heavy Aviation Army Truck	7	Front 36 x 6 solids; rear, 36 x 10 dual solids	Truck and all equipment new at beginning of the series of runs.
F. W. D. 3-ton Truck	9,120 lb. empty 14,650 lb. loaded	40 x 8 cord tires for one series 100-125 lb. inflation; 36 x 6 smooth tread solid tires for one series	Driving centers removed from all wheels. Wheel bearing friction only internal resistance. Equipment new at beginning of the series of runs.

with sufficient rapidity, especially during the tests.

The Drewery testometer is a liquid accelerometer consisting of a U-tube attached to a small reservoir and arranged so that any retardation or acceleration in the line of the tube of the instrument causes the liquid

TABLE II. RESISTANCE TO TRANSLATION ON GRAVEL SURFACE
(Rolling, Impact and Air Resistances and Internal Resistance up to the Neutral Gear)

Run	Draft Pounds per Ton	Remarks
1	114.4	Dynamometer tests were made up a 5.85% grade with a good, hard smooth gravel surface. Speed approximately 6 mi. per hour. Tires inflated to 75 lb. per sq.in. Gross load 8,300 lb. Gear shift in neutral.
2	187.8	
3	174.6	
4	175.9	
5	143.4	
6	173.3	
7	121.6	
8	91.6	
9	146.9	
10	122.8	
11	186.6	
12	174.6	
13	174.6	
14	144.5	
15	177.2	
16	127.7	
17	91.6	

Average of all determinations..... 148.5
Subtract for effect of grade..... 117.0

Equivalent average draft for 0.0 grade..... 31.5 lb. per ton

to flow in the tube to a position of equilibrium, thus indicating the accelerating force. The instrument is attached to the vehicle, and, by means of an adjusting screw, set at zero when the car is standing on a level place. In general the use of the testometer was subject to the same difficulties as were experienced with the Wimperis instrument.

Space-Time Recorder Most Dependable—Several years ago David L. Gallup, consulting engineer for the Nordyke-Marmon Co., of Indianapolis, Ind., served as chairman of a committee of the Society of Automotive Engineers that developed an accelerometer for use with motor vehicles and used it in some research work. The

TABLE III. RESISTANCE TO TRANSLATION ON BITULITHIC PAVEMENT
(Rolling Impact and Air Resistances and Internal Resistance up to the Neutral Gear)

Run	Draft Pounds per Ton East	West	Remarks
1	48.7	21.2	Heavy aviation truck. Gears in neutral. Runs on Bitulithic pavement. Lincoln Way, Ames, Iowa. Speed approximately 8 miles per hour. Gross load 8 tons. Temperature 65° F.
2	38.2	36.9	
3	39.4	37.5	
4	35.6	39.4	
5	35.6	36.2	
6	28.8	35.7	
7	28.2	41.2	
8	28.2	36.2	
9	24.4	35.7	
10	27.5	13.8	
11	28.2	20.0	
12	24.4	21.8	
13	23.8	25.0	
14	30.0	24.4	
15	30.6	25.0	
16	34.4	17.5	
17	34.4	23.1	
18	40.0	18.5	
19	35.6	16.5	
20	40.0	21.9	
21	36.3	21.2	
22	40.6	40.6	

Average for all determinations..... 30.5 lb. per ton

instrument and its use are described in *The Automobile*, June 28, 1917, p. 1230.

Mr. Gallup loaned his instrument for the work at Ames and after giving it a thorough trial we concluded that it offered a most dependable means of measuring tractive resistance by the retardation method. Mr. Gallup had to recall his instrument before the Ames work could be finished and one of our own design, but similar in principle, was constructed for the completion of the Ames investigations.

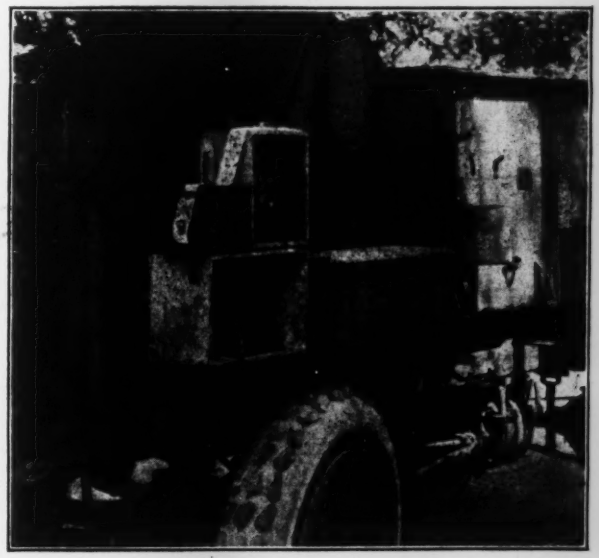


FIG. 1—SPACE-TIME RECORDER ATTACHED TO TRUCK

In its final form the instrument, which is illustrated in Fig. 1, consists of a paper feed that moves the paper through the recorder at a fixed ratio to the distance the vehicle travels, and a time recording pen. The paper-feed roll is driven from a gear on the front wheel of the vehicle, through an ordinary speedometer cable. A clock mechanism actuates the pen so that a break occurs in the ink line every one-half second. Fig. 3 shows a section of one of the records from the instrument.

It does not seem to be generally understood that the resistance to the translation of a motor vehicle really consists of several quantities that may vary independently of each other. It is convenient to consider the following combination of these factors:

1. Rolling resistance, due to the interaction of wheel and road surface, and which usually is understood to include wheel bearing friction.

2. Internal resistance, which is made up of bearing friction and gear friction, including the effect of the lubricant in the gear housings, in all parts back of the clutch. Usually wheel bearing friction is excluded.

3. Motor resistance, which includes friction in the

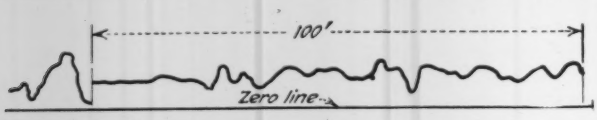


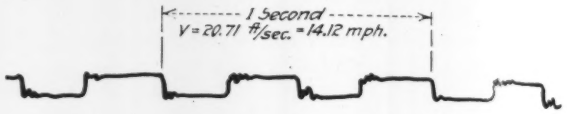
FIG. 2—RECORD FROM THE DAVIDSON DYNAMOMETER

motor itself and the power requirements of engine auxiliaries, such as the pump, generator and fan.

4. Air resistance, which is the effect of the relative speed of the vehicle and the air.

These various resistances are usually expressed in terms of equivalent force applied at the rear axle and the customary unit is *pounds per ton* of weight of vehicle.

The diagram in Fig. 4 shows the approximate values of certain of these resistances for the light aviation truck when traveling on a paved road surface.



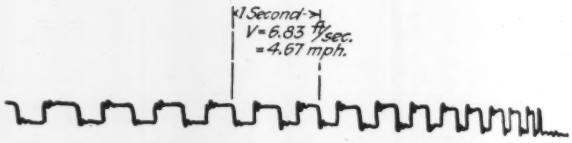
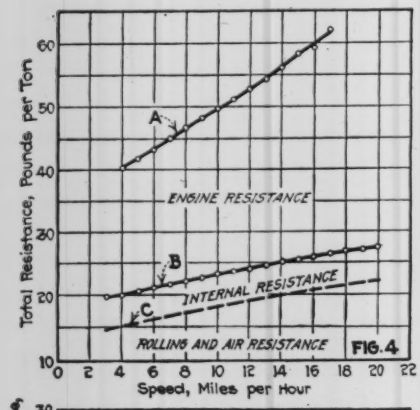
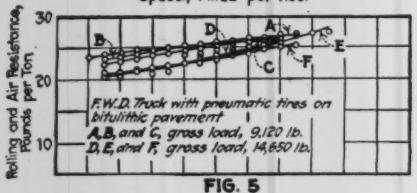
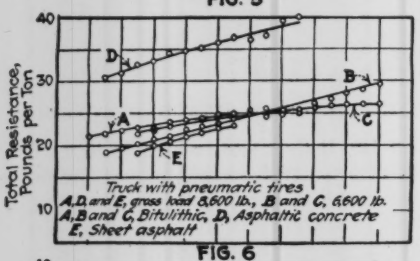
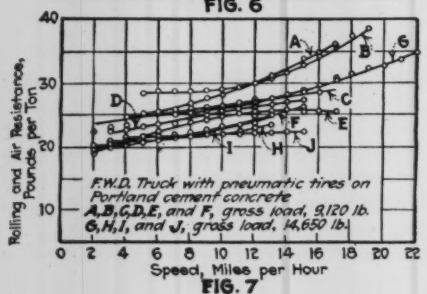


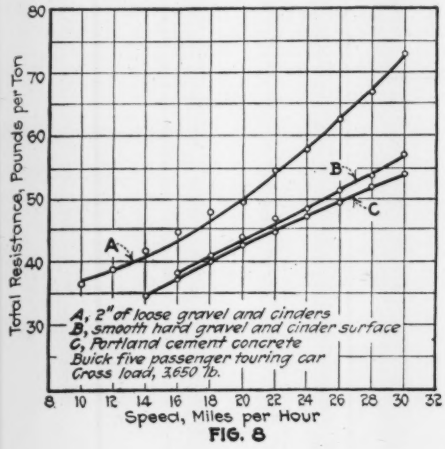
FIG. 3—RECORD FROM THE SPACE-TIME RECORDER

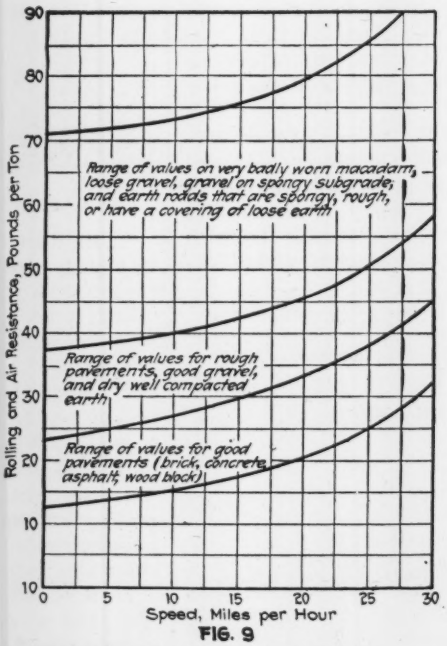











Rolling and Air Resistance, Pounds per Ton
Range of values on very badly worn macadam, loose gravel, gravel on spongy subgrade, and earth roads that are spongy, rough, or have a covering of loose earth
Range of values for rough pavements, good gravel, and dry well compacted earth
Range of values for good pavements (brick, concrete, asphalt, wood block)
Speed, Miles per Hour
FIG. 9

FIGS. 4 TO 9—TYPICAL AND SUMMARY CURVES OF TRACTIVE RESISTANCE ON VARIOUS ROAD SURFACES

Fig. 4—Approximate values of the various resistances of the "Light Aviation" truck on a paved road surface. Fig. 5—Values of rolling resistance plus air resistance. Fig. 6—Values of total resistance up to the neutral gear, pneumatic tire truck. Fig. 7—Values of rolling resistance plus air resistance. Fig. 8—Values of total resistance up to the neutral gear, Buick touring car. Fig. 9—Range of values of rolling resistance on various classes of surface. From about 100 determinations with many types of vehicles.

It will be noted that rolling resistance is directly influenced by the character of the road surface, although internal resistance may be influenced indirectly. The other resistances are not particularly influenced by the character of the road surface.

Figs. 5 to 8, inclusive, show the results of some of the measurements of tractive resistance. In some instances the total resistance up to the clutch was measured. The significant information so far obtained is indicated by Fig. 9 which shows the range of values of rolling resistance (including air resistance) for all determinations that have been made at Ames or those made elsewhere in so far as the reports have been available. Specific investigations are now in progress with a view to developing the law of variation within the zones indicated in Fig. 9. The averages of the values from this diagram are used in Table V.

Gasoline Consumption Determinations—In order to secure a check on the relation of tractive resistance to fuel consumption, a number of trial runs were made on a few types of road surface, on highways with very low grades, for the purpose of securing data on fuel consumption. Needless to say these data are comparative only and even the same vehicle will give periodic variations in fuel consumption. It would not be safe to assume that exactly the same number of ton-miles per gallon of gasoline could be obtained on the same road with another vehicle, even of the same type. The

TABLE IV. GASOLINE CONSUMPTION DETERMINATIONS

Run	Kind of Road Surface	Distance Traveled Miles	Ton-Miles per Gal. of Gas
1	Gravel—Some soft places	60	19.8
2	Gravel—Hard and smooth	51	21.7
3	Gravel—After summer shower	6	18.5
4	Gravel—Hard and dry	10.5	21.9
5	Gravel—After summer shower (same road as run 4)	10.5	19.0
6	Gravel—Hard and smooth	71.0	22.0
7	Monolithic brick in excellent condition	10.78	29.4
8	Same as run 7 on another day	10.78	30.0
9	Portland Cement concrete—excellent condition	68	30.7
10	Bitulithic, excellent, in August	13	22.7
11	Bitulithic, excellent, in September	8	24.3

Averages for all runs

Type of Surface	Ton-Miles per Gal. of Gas
Earth (generally in poor condition)	14.0
Gravel	21.2
Monolithic brick	29.7
Portland cement concrete	30.6
Bitulithic	23.4

runs were all with the heavy aviation army truck carrying a gross load of 8 tons and a net load of 3.5 tons.

Table V shows the relation between fuel consumption and tractive resistance and is of interest as a check on the results obtained by two widely different methods of studying the subject.

The gasoline consumption on good paved surfaces is shown as unity and consumption on other surfaces in comparison therewith. Obviously the values for inferior surfaces can be only general averages. The relative tractive resistance is shown in the column at the extreme right. This table indicates surprisingly close agreement among the various quantities.

With Table V as a basis, and a known tonnage over a highway, the engineer can compute the minimum justifiable expenditure for any change in surface type.

Conclusions—The results of the experiments indicate that about half of the fuel consumed by the motor car or truck, under normal operating conditions on good surfaces, is required to operate the mechanism of the vehicle and to overcome air resistance. The

TABLE V. RELATION BETWEEN FUEL CONSUMPTION AND TRACTIVE RESISTANCE

Type	Source of Data: Ames[1]	Canadian[2] Engineer	A. N.[3] Johnson	Relative Tractive Resistance
Good pavement	1.00	1.00	1.00	1.00
Macadam and Bit. Mac.		1.23	1.24	1.20
Gravel	1.43	2.1	1.64	1.6
Earth	2.10	2.03	2.04	2.20

[1]See Table IV; [2]Canadian Engineer, Aug. 29, 1922, p. 303; [3]Engineering News-Record, Nov. 7, 1918, p. 843.

possibilities of saving fuel to the motor car driver who uses paved surfaces are confined to the prevention of dissipation of energy by impact on rough surfaces.

There is no marked difference in the actual rolling resistance of rubber tired vehicles over concrete, brick or sheet pavements that are in good repair. Unevenness of surface due to poor construction or inadequate maintenance is immediately reflected in an increase in tractive resistance which may reach a value equal to 1.25 times that of the same type of surface in good repair.

If the motor car driver must use low grade surfaces, a markedly larger fuel consumption is required to propel the vehicle than on paved surfaces and it is easily possible that on heavily traveled trunk lines, the change to a better type of surface would save enough fuel to liquidate the cost of the improvement.

The sheet asphalt and asphaltic types show much higher resistance in hot weather than in cold.

The rolling resistance on the low-grade surfaces such as macadam, gravel and earth is an exceedingly variable quantity, as would be expected.

Navigable Waters in the Water Power Act

MUCH doubt exists as to the exact authority of the federal government in the execution of the Water Power Act to control intra-state streams under the commerce clause of the Constitution and a suit by the State of New York to define this authority is now before the courts. It is interesting, therefore, to note the interpretation of the situation given by O. C. Merrill, executive secretary of the Federal Power Commission, in a paper read at the San Francisco meeting of the American Society of Civil Engineers, Oct. 4, 1922. His remarks on this phase of the act follow:

When power projects involve lands or other property of the United States the jurisdiction of the commission admits of no doubt. Ownership is a question of fact, and when the fact is established, the authority of the commission is clear and is exclusive. Outside of the public lands and reservations the jurisdiction of the commission involves two classes of streams; first, those streams which are defined in the act as "navigable waters," over which the commission has direct jurisdiction, and in which development cannot lawfully be made without its prior approval; and second, those non-navigable tributaries of navigable waters in which power development by altering the natural flow would affect the navigable capacity of the navigable waters. The second class come under the jurisdiction of the commission only when declarations of intention to construct dams within them are filed with the commission.

The Act defines navigable waters as "those parts of streams or other bodies of water over which Congress has jurisdiction under its authority to regulate commerce with foreign nations and among the several states, and which either in their natural or improved condition notwithstanding interruptions between the navigable parts of such streams or waters by falls, shallows, or rapids compelling land carriage, are used or suitable for use for the transportation of persons or property in interstate or foreign commerce, including therein all such interrupting falls, shallows, or rapids; together with such other parts of streams as shall have been authorized by Congress for improvement by the United States or shall have been recommended to Congress for such improvement after investigation under its authority."

Whether a stream has been recommended for improvement, or improvement has been authorized or actually made, is a simple question of fact. Whether it is used in the transportation of persons or property in interstate or foreign commerce is also a question of fact which may be determined upon investgation; but whether if so, the amount or character of such commerce is sufficient to warrant the assertion of jurisdiction by the commission is a matter for decision in the individual case. Similarly, whether a stream which is not now used in interstate or foreign commerce is suitable for such use is a matter of judgment, and decision must rest upon the character of the stream and upon the probability of the future development of commerce.

The Act provides a procedure whereby anyone proposing to build a dam in any stream of doubtful status may make declaration of his intention and have the matter conclusively determined by the commission. There has been criticism, particularly in the New England States, that the definition contained in the Act is not clear and that the Act should be so modified or the definition so interpreted by the commission that the limit of navigability on any stream may be determined with such exactness that no one need ever be in doubt or apply to the commission for determination.

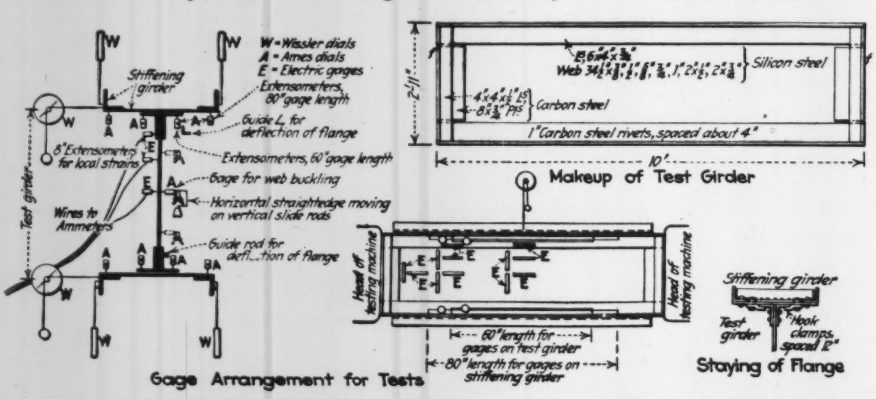
The question of navigability is not one of mathematical formulas, and there is no more probability that it can be removed from the domain of individual judgment, than that our laws in general can be drawn with such precision that the services of the courts in their interpretation can be dispensed with. The decisions of the commission in the individual cases presented to it will establish precedents that will gradually clear the situation.

Wide-Web Column Tests for Delaware River Bridge

Web-Plate Proportioning Is Being Studied to Check Tower Design—Bending Tests of Cable Sections Also Planned

STRENGTH tests of fourteen wide-web columns are in progress at the Bureau of Standards for the Delaware River Bridge Joint Commission, which is building the 1,750-ft. suspension bridge between Philadelphia and Camden. In the construction of the towers of this bridge, which are cellular columns built up of plates and angles, the permissible ratio of thickness to unstayed width of plate webs is an important factor. Under existing practice, well fixed in bridge specifications since the tests reported by Bouscaren before the American Society of Civil Engineers in 1880, a compression plate should not be wider between lines of support than thirty times its thickness.

The tests are planned to investigate the validity of this rule, based on tests of three columns with 12-in. channel webs, as well as to determine the effect of various elements of manufacture, such as the inevitable presence of slight buckles or waves in the web plate, on the strength of the column.


W = Wissler dials
A = Ames dials
E = Electric gages
Stiffening girder
Extensometers, 60" gage length
Guide L for deflection of flange
8" Extensometer for local strains
Extensometers, 60" gage length
Gage for web buckling
Horizontal straightedge moving on vertical slide rods
Wires to Ammeters
Guide rod for deflection of flange
Test girder
Gage Arrangement for Tests
Silicon steel
Carbon steel
1" Carbon steel rivets, spaced about 4"
Makeup of Test Girder
Head of testing machine
60" length for gages on test girder
80" length for gages on stiffening girder
Stiffening girder
Test girder
Hook clamps, spaced 12"
Staying of Flange

TEST COLUMN FOR INVESTIGATING RATIO OF WEB WIDTH TO THICKNESS

Seven test sections with different web thicknesses have been built, and two specimens of each are being tested. Under present practice a compression plate should not be wider between lines of support than thirty times its thickness; in these tests, widths ranging up to twice as great will be tested.

These tests are part of a larger test program which will be carried out to verify important elements of the construction of this bridge, or to give a more adequate basis for the calculation of certain auxiliary actions. Among the other tests for which definite plans have been made are bending tests on a 20-ft. length of 10-in. cable, wrapped as in the finished cable, to determine the influence of slip between the individual cable wires upon the resistance to bending (which determines the secondary stresses in the cable); and tests of the strength of a cable strand laid up around a strand shoe.

Column-Test Program—The fourteen test specimens of the present column tests, as represented in the sketch herewith, are square-end columns of I-shaped section 35 in. wide by 10 ft. long, composed of four 6 x 4 x ⅜-in. angles and a 34½-in. web, giving a clear width of web plate between edges of flange angles of 23 in. The web thicknesses of the several columns are ⅜ in., ½ in., ⅝ in., ¾ in., 1 in., 2 x ½ in., and 2 x ¾ in. The material is silicon steel, with about 80,000 lb. per square inch ultimate strength and 45,000 lb. per square inch yield point.

The tests are made in the large horizontal hydraulic Emery machine of the Bureau of Standards; the columns are tested with the plane of the web vertical. Directly above and below the flanges are horizontal channel-shaped stiffening girders to hold the test column against lateral deflection just as it would be held by transverse webs or bracing in the actual structure. These stiffening girders take no longitudinal stress; they are shorter than the test girder and are not connected to it but hold it laterally by means of lubricated hook-shaped clamps.

Four extensometers of 60-in. gage length on the outstanding legs of the flange angles measure the general longitudinal compression of the column in the test. Check measurements of compression are taken on the stiffening girders, to verify the absence of longitudinal stress in them. The lateral and longitudinal strains in the web of the test column are measured by ten 8-in. extensometers of a new form, in which the longitudinal movement is measured by the variation of resistance of carbon plates in contact, indicated by ammeters at the reading table.

In addition, the shape of the web plate is measured by offset readings from fixed straightedges adjacent to one side of the web, these offsets being measured by dial gages. Readings are taken along three gage lines, one on the middle line of the web and one near each of the flanges, and at 3-in. intervals on each gage line.

Character of Test Indications—Two of the test columns have been tested at the time of writing, one with ⅜-in. web and the other with ¾-in. web. The maximum loads reached in the two cases were approximately 41,000 and 44,000 lb. per square inch, respectively, the thinner web unexpectedly showing the higher strength, probably because of its containing metal of slightly higher inherent strength.

The significant fact observed in both of these tests was that the outward buckling of the web during the test and after failure was precisely the same (though magnified) as that which existed before the test. Thus, in one test the original offset measurements on the web showed two slight dome-shaped buckles, several feet apart, each occupying most of the width between flange angles; during the test these buckles grew outward, without change in position or size, and remained as permanent distortions of the web after failure. The stress lines which appeared on the web toward the close of the test were everywhere related to the outline of these pre-existing irregularities of web profile.

State Auctions Old Steel Bridges

Nineteen old steel bridges were sold at auction by the Indiana Highway Commission this week, following the successful trial of this method last year, when ten or twelve bridges were sold.

Colorado River Compact Provides Definite Water-Use Allocation

Treaty Must Be Ratified by Congress and Seven Legislatures—Agricultural, Domestic Uses First—Present Rights Guarded

As reported in Engineering News-Record, Nov. 23, p. 902, a treaty has been formulated whereby equitable allocation of the uses of the Colorado River has been arrived at. At the time that the item referred to above was printed definite details concerning the compact were lacking. On Nov. 25 the U. S. Department of Commerce issued a report in explanation of the conf rence, attended by executives involved and by federal representatives. That report, only slightly modified, is reprinted herewith.—EDITOR.

THE STATES of Arizona, California, Colorado, Nevada, New Mexico, Utah, and Wyoming have resolved to enter into a compact under the act of Congress approved Aug. 19, 1921 (42 Statutes-at-Large, page 171), and the acts of the legislatures of the said states. Their commissioners, W. S. Norviel for Arizona, W. F. McClure for California, Delph E. Carpenter for Colorado, J. G. Scrugham for Nevada, Stephen B. Davis, Jr., for New Mexico, R. E. Caldwell for Utah, Frank C. Emerson for Wyoming, after negotiations participated in by Herbert Hoover, appointed by the President as the representative of the United States, have agreed upon the following articles:

Article I. Purposes of Compact—The major purposes of this compact are (1) to provide for equitable division and apportionment of the use of the waters of the Colorado River System, (2) to establish the relative importance of different beneficial uses of water, (3) to promote interstate comity, (4) to remove causes of present and future controversies, and (5) to secure the expeditious agricultural and industrial development of the Colorado River Basin, the storage of its waters, and the protection of life and property from floods. To these ends the Colorado River Basin is divided into two basins, and an apportionment of the use of part of the water of the Colorado River system is made to each of them with the provision that further equitable apportionments may be made.

Article II. Territorial Definitions—As used in this compact: (A) The term "Colorado River System" means that portion of the Colorado River and its tributaries within the United States of America. (B) The term "Colorado River Basin" means all of the drainage area of the Colorado River System and all other territory within the United States to which the waters of the Colorado River System shall be beneficially applied. (C) The term "States of the Upper Division" means the states of Colorado, New Mexico, Utah, and Wyoming. (D) The term "States of the Lower Division" means the states of Arizona, California, and Nevada. (E) The term "Lee Ferry" means a point in the main stream of the Colorado River 1 mile below the mouth of the Paris River. (F) The term "Upper Basin" means those parts of the states of Arizona, Colorado, New Mexico, Utah, and Wyoming within and from which waters naturally drain into the Colorado River System above Lee Ferry, and also all parts of said states located without the drainage area of the Colorado River System which are now or shall hereafter be beneficially served by waters diverted from the system above Lee Ferry. (G) The term "Lower Basin" means those parts of the states of Arizona, California, Nevada, New Mexico, and Utah within and from which waters naturally drain into the Colorado River system below Lee Ferry, and also all parts of said states located without the drainage area of the Colorado River System, which are now or shall hereafter be beneficially served by waters diverted from the system below Lee Ferry. (H) The term "domestic use" shall include the use of water for household stock, municipal, mining, milling, industrial, and other like purposes, but shall exclude the generation of electrical power.

Article III. Allocation of Water—(A) There is hereby apportioned from the Colorado River System in perpetuity to the upper basin and to the lower basin, respectively, to exclusive beneficial consumptive use 7,700,000 acre-ft. of water per annum, which shall include all water necessary for the supply for any rights which may now exist. (B) In addition to such apportionment the lower basin is hereby given the right to increase its beneficial consumptive use of such waters by 1,000,000 acre-ft. per annum. (C) If, as a matter of international comity, the United States shall hereafter recognize in the United States of Mexico any right to use of any waters of the Colorado River System, such waters shall be supplied first from the waters which are surplus over and above the aggregate of quantities specified in (A) and (B); and if such surplus shall prove insufficient for this purpose, then such deficiency shall be equally borne by the upper basin and the lower basin, and whenever necessary the states of the upper division shall deliver at Lee Ferry water to supply one-half of the deficiency so recognized in addition to that provided in (D). (D) The states of the upper division will not cause the flow of the river at Lee Ferry to be depleted below an aggregate of 75,000,000 acre-ft. for any period of ten successive years reckoned in continuing progressive series beginning with Oct. 1 succeeding the ratification of this compact. (E) The states of the upper division shall not withhold water, and the states of the lower division shall not require the delivery of water which cannot reasonably be applied to domestic and agricultural uses. (F) Further equitable apportionment of the beneficial uses of the waters of the Colorado River System unapportioned in (A), (B) and (C) may be made in the manner provided in (G) at any time after Oct. 1, 1963, if and when either basin shall have reached its total beneficial consumptive use as set out in (A) and (B). (G) In the event of a desire for a further apportionment as provided in (F) any two signatory states, acting through their governors, may give joint notice of such desire to the governors of the other signatory states and to the President of the United States, and it shall be the duty of the governors of the signatory states and of the President forthwith to appoint representatives, whose duty it shall be to divide and apportion equitably between the upper basin and lower basin the beneficial use of the unapportioned water of the Colorado River System as mentioned in (F) subject to the legislative ratification of the signatory states and the Congress of the United States.

Article IV. Agricultural and Domestic Uses Dominant—(A) Inasmuch as the Colorado River has ceased to be navigable for commerce, and reservation of its waters for navigation would seriously limit the developments of its basin, the use of its waters for purposes of navigation shall be subservient to the uses of such waters for domestic, agricultural, and power purposes. If Congress shall not consent to this paragraph, the other provisions of this compact shall nevertheless remain binding. (B) Subject to the provisions of this compact, water of the Colorado River System may be impounded and used for the generation of electrical power but such impounding and use shall be subservient to the use and consumption of such water for agricultural and domestic purposes and shall not interfere with or prevent use for such dominant purposes. (C) The provisions of this article shall not apply to or interfere with the regulation and control by any state within its boundaries of the appropriation, use and distribution of water.

Article V. Compilation of Hydraulic Data—The chief official of each signatory state charged with the administration of water rights, together with the director of the U. S. Reclamation Service and the director of the U. S. Geological Survey shall co-operate, ex officio: (A) To promote the systematic determination and co-ordination of the facts as to flow, appropriation, consumption, and use of water in the Colorado River Basin, and the interchange of available information in such matters; (B) to ascertain and publish

the annual flow records of the Colorado River at Lee Ferry; and (C) to perform such other duties as may be assigned by mutual consent of the signatories from time to time.

Article VI. Claim Adjustments—Should any claim or controversy arise between any two or more of the signatory states: (A) With respect to the waters of the Colorado River System not covered by the terms of this compact; (B) over the meaning or performance of any of the terms of this compact; (C) as to the allocation of the burdens incident to the performance of any article of this compact or delivery of waters as herein provided; (D) as to the construction or operation of works within the Colorado River Basin to be situated in two or more states, or to be constructed in one state for the benefit of another state; or (E) as to the diversion of water in one state for the benefit of another state, the governors of the states affected, upon the request of one of them, shall forthwith appoint commissioners with power to consider and adjust such claim or controversy, subject to ratification by the legislatures of the states so affected.

Nothing herein contained shall prevent the adjustment of any such claim or controversy by any present method or direct future legislative action of the interested states.

Article VII.—Nothing in this compact shall be construed as affecting the obligations of the United States of America to Indian Tribes.

Article VIII. Existing Rights Unimpaired—Present perfected rights to the beneficial use of waters of the Colorado River System are unimpaired by this compact. Whenever storage capacity of 5,000,000 acre-ft. shall have been provided on the main Colorado River within or for the benefit of the lower basin, then claims of such rights, if any, by appropriators or users of water in the lower basin against appropriators or users of water in the upper basin shall attach to and be satisfied from water that may be stored not in conflict with Article III. All other rights to beneficial use of waters of the Colorado River System shall be satisfied solely from the water apportioned to that basin in which they are situated.

Article IX. Enforcement Provisions—Nothing in this compact shall be construed to limit or prevent any state from instituting or maintaining any action or proceeding, legal or equitable, for the protection of any right under this compact or the enforcement of any of its provisions.

Article X. Treaty Termination—This compact may be terminated at any time by the unanimous agreement of the signatory states. In the event of such termination all rights established under it shall continue unimpaired.

Article XI.—The compact shall become binding and obligatory when it shall have been approved by the legislatures of each of the signatory states and by the Congress of the United States. Notice of approval by the legislatures shall be given by the governor of such signatory state to the governors of the other signatory states and to the President of the United States, and the President of the United States is requested to give notice to the governors of the signatory states of approval by Congress.

The compact, signed by each of the commissioners and approved by Secretary of Commerce Hoover, has been sent to the State Department archives. A certified copy has been forwarded to the governor of each of the signatory states. The compact was signed at Sante Fé, N. M., Nov. 24, by the commissioners mentioned in the first paragraph of this article.

I.C.C. Postpones Hearing on Utah Central

The hearing scheduled to take place before the Interstate Commerce Commission on Nov. 25, in the matter of the application of the Utah Central R.R. for a certificate of public convenience and necessity, authorizing it to construct a line of railroad, has been postponed until Dec. 29. The hearing will take place in Washington before Examiner H. C. Davis.

LETTERS TO THE EDITOR

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Hydraulic Laboratories in the United States

Sir—Since the publication in *Engineering News-Record*, Sept. 28, p. 507, of the table of hydraulic laboratories compiled by Engineering Foundation, we have received information from four additional laboratories and transmit this in the form of your table.

Name of Laboratory	Year Established	Possibilities for Outside Work	Number on Regular Staff
U. S. Engineer Department	1921	No	One
I. P. Morris Hydraulic Testing Laboratory	1919	Not given	Six
Midwest Engine Co.	1912	Have not done testing for outside concerns	Six
Oregon State Agricultural College	1919	Limited	Two

Besides the laboratories listed, we have been informed that the following also have hydraulic laboratories, but have not yet received responses to our inquiries for detailed information:

Underwriters' Laboratories, Chicago, Ill.; State College of Washington, Pullman, Wash.; University of Washington, Seattle, Wash.

ALFRED D. FLINN,
New York City. Director, Engineering Foundation.

Repairing the Gibraltar Dam Spillway

Sir—In *Engineering News-Record*, Nov. 9, p. 798, there appeared an article written by me on "Repairing the Spillway to the Gibraltar Dam." I wish to correct an error in the third line on p. 801. This sentence should have read: "Because free discharge into air can be secured, the work will be constructed so as to prevent the formation of a standing wave on the paving." The use of the word "cannot" is quite misleading and might easily bring about an erroneous conclusion.

R. A. HILL,
Quinton, Code & Hill, Consulting Engineers.
Los Angeles, Calif., Nov. 22.

Driving Piles Near Existing Structures

Sir—The article "Pile Driver Slides Back and Forth on Two Greased Poles," in the *Engineering News-Record* of Nov. 23, p. 895, reminds the writer of an experience of a number of years ago when such practice caused serious trouble.

In 1893 the New York, New Haven and Hartford R.R. built a two-track pile trestle across the West Haven meadows adjacent to an existing two-track pile trestle. The work was done in connection with the four track work between New Haven and the Housatonic River. The meadow consists of alternate layers of apparently stiff clay and spaces filled with very soft marshy mud. Driving was started at the west end with a driver mounted as described in the article referred to. Bents had eight piles each, and were in line with the bents of the old trestle, the ends of the caps touching but not being connected otherwise. The first bent was started by driving the pile next the old trestle. The driver was slid sideways for each successive pile until the bent was completed, and was then rolled back to the next bent which was driven from the outside in. The third bent was then driven from the inside out, and the fourth from the outside in, and so on until about two-thirds of the 2,300 ft. were completed.

There had been slight movements of the old trestle due to the displacement from the new piles, but nothing serious had occurred. At about the two-thirds point, however, where the hardpan bottom was some 50 ft. below the marsh surface, the old trestle suddenly moved sideways, an amount which actually proved to be but a trifle over 2 ft., but which

put a kink in the track that made the movement appear ten times as much.

Luckily the movement occurred in daylight just after a heavy train had passed. It was possible to reline the track sufficiently to permit slow operation before the next train was due, and some additional movement which occurred throughout the next day or two was easily taken care of. The rest of the bents were driven from the trestle outward. This necessitated sliding the driver back for each bent, and somewhat slowed down the work, but it entirely obviated any further trouble.

The large amount of material displaced by a pile group is not often realized, and as a rule it causes little trouble. It is, however, a matter which should be given consideration whenever piling is driven in proximity to other structures, particularly if they are of a character or age which renders them liable to disturbance. CHARLES RUFUS HARTE,

New Haven, Conn., Nov. 25. Construction Engineer.

Sanitation, Ventilation and Vaccination

Sir—Many engineers would like to see our profession given its due share of recognition for what it has accomplished in the work for public health, both in civil and military life. We are told that the span of life is increasing; is this due to shortening the work day and sanitation or to something else? For years the work day was twelve hours, then it was ten, and now it is eight. Eight hours appears to be the proper working period for manual labor. Paralleling this shortening of hours has been the development of sanitation and safety, to which engineers have been large contributors.

During the war there was an absence of typhoid and smallpox epidemics. Was this due to supplying the camps with good water, providing for sewage disposal and burning garbage and other camp refuse or to vaccination and inoculation?

The Army Medical *Bulletin* for Aug. 15, 1922, under the caption "Anti-Pneumonia Vaccination," states: "The ideal method of controlling the spread of an epidemic disease is that of rendering the susceptible individual immune by artificial measures. This procedure is peculiarly applicable to military life, where each person is governed by regulations promulgated by a central authority. Certain diseases, typhoid and paratyphoid fevers and smallpox, have been practically eliminated from the Army by the production of an active immunity by vaccination, but on the other hand we still have the great group of respiratory diseases which have remained unconquered by either vaccination or sanitary measures.

"The control of infections of the respiratory tract constitutes the greatest problem in present day preventive medicine. Modern sanitation has to a great extent failed to prevent the spread of these diseases, especially that of influenza and the pneumonias. Consequently, many workers in the field of preventive medicine are directing their attention to methods of rendering the individual immune to the infection rather than protecting him from the invading organism. Should their efforts be successful the result will be removal of the greatest menace to the life of the soldier in time of war."

Without splitting hairs would it not be truer to state that modern ventilation, and not modern sanitation, has to a great extent failed to prevent the spread of infections of the respiratory tract? In the Jerry built barracks where men were quartered during the late war, windows were kept open without any regard to the health and comfort of the enlisted men. Drafts would sweep through the rooms with the intensity of Arctic gales, carrying germs from scores of coughing men into every nook and cranny. As the bedding was scant and insufficient, the soldiers at night would close the windows. Guards tramping through the buildings would rout such violators from their cots and make them let in the four winds of heaven. To men sick and feverish from the reactions of smallpox and typhoid inoculations such treatment is not soon forgotten.

In our schools we have the same things to contend with. Our children are required to sit in drafts, and as a consequence are out of school with coughs and colds. Common sense and teaching seems to be as far apart as the poles, or a greater effort would be made to air the rooms during recess time, thus protecting the children from drafts during the study periods.

The solution of this problem is squarely up to the engineer and architect. We must learn how to ventilate our buildings. Air can be carried between the walls, and floors should have registers or suitable openings. The objects of ventilation would be to supply fresh air and maintain the proper temperature. Windows are for light and should only be used for this purpose during the winter months.

The means for attaining health depend largely upon the point of view. If a man wants to improve upon the work of God, then inoculations are no doubt a good thing, but if on the other hand he only aspires to improve upon his own handiwork, then his time can be more profitably employed in studying the preparation of foods, sanitation, heating and ventilation. F. W. HARRIS.

Renton, Wash., Nov. 20.

[Why not sanitate, ventilate and vaccinate?—Editor.]

Bridge Floor That Resisted Fire

Sir—The article on fire prevention in timber floors of highway bridges in *Engineering News-Record* for Nov. 9, p. 796, is timely and full of interest. In this connection I desire to call your attention to a fire on a county bridge known as No. 6 Little Deer Creek, in the mining village of Russelton.

This is a 31-ft. steel through plate-girder with 17 ft. clear width between girder flanges. The floor system consists of steel floor beams, steel stringers, creosoted nailing pieces bolted to the stringers, creosoted yellow pine plank and creosoted wood block. The roadway is defined by steel angle wheel guards on either side. There is an open space of about 8 in. between the web of the girder and the edge of the floor. The clear water-way below the girders is slightly more than 6 ft. A 2-in. oil line, laid in the bed of the stream, passed under the bridge and, in September of this year, it sprang a leak from some unknown cause, permitting the oil to spread over the surface of the water. It was reported that a miner crossing the bridge lighted a newspaper and dropped it into the floating oil. The resulting fire caused the greater portion of the surface of the stone to spall off, burned nearly all the paint off the steelwork, charred the under side of the planking, and then went out.

As the bridge was not put out of service, these facts did not come to the attention of this office for nearly a month. Conditions seemed so favorable for complete destruction of the floor that it was a matter of surprise that no more serious damage resulted.

V. R. COVELL,
County Engineer, Allegheny County.

Pittsburgh, Nov. 28.

Purchase-Valuation of Stockton Water-Works

The water-works property of the Pacific Gas & Electric Co., at Stockton, Calif., has been valued at $1,400,000 by the State Railroad Commission in proceedings brought by the city to acquire the property. Engineers for the city valued the property at $841,683 and $1,332,736. The company's claim was $2,555,185, but this included some items not in the other inventories for which the commission made an allowance. The commission states in its report that the revenues of 1921 are at the rate of only 1.65 per cent on the company's valuation, but that for some years past the company has earned more than its operating expense and thus is entitled to some "going concern" allowance—an amount not stated in the commission's valuation, which under the statute is reported as a lump sum. The population of Stockton by the last three censuses was: 1920, 40,296; 1910, 23,252; 1900, 17,506.

NEWS OF THE WEEK

New York, December 7, 1922

End Long Controversy Over Morris Canal

State Gets Water Rights and Small Basin while L. V. R. R. Retains Big Terminal Basin

Agreement for the abandonment of the Morris Canal across New Jersey by the Lehigh Valley R.R. has been reached between the railroad company and the state Morris Canal Commission. The company is to retain the big basin on the Hudson River waterfront of Jersey City, all the canal bed in that city west of the basin and a strip of canal bed at Phillipsburg. The state gets the canal bed east of Washington St., Jersey City, the little basin, which contains about 20 acres, and the canal bed between Jersey City and Phillipsburg. The state gets also all water-rights, securities, other personal property of the Morris Canal & Banking Co., and the sum of $875,000 payable in five instalments beginning Dec. 15. The railroad company is to maintain the canal until March 1, 1923.

The Morris Canal is 107 miles long and connects the Hudson, at Jersey City, with the Delaware at Phillipsburg, N. J. It was built under a charter granted in 1824 to run for 99 years. If at the end of that period the state should fail to exercise a purchase option the charter was to run for another 50 years and in 1974 the entire property was to revert to the state.

Canal Leased in 1871

In 1871 the canal was leased to the Lehigh Valley R.R. and about 20 years ago navigation was practically abandoned. Since then the waterway has been the occasion of much controversy between the state, the railroad company, and the communities along its banks. The river terminals at Jersey City have become of great value to the railroad company and the water-rights involved in its charter have been a matter of considerable concern to the state and to the municipalities of northern New Jersey.

The Morris Canal Commission was created by the state legislature at its last session to negotiate an agreement with the railroad company and to report its action to the legislature not later than Dec. 1, 1922.

New York City Adopts 1923 Budget of Over $353,000,000

The budget of the City of New York for the year 1923, as adopted by the Board of Estimate and Apportionment Oct. 31 and approved by the Board of Aldermen on Dec. 4, totals $353,350,976. This includes budgets for the five counties within the city aggregating nearly $10,600,000 and nearly $12,600,000 of state tax. The detailed budget was published in the *City Record* (New York City) for Nov. 14, 1922. Nearly $85,000,000 of the $353,000,000, or almost 25 per cent, for debt service, is $17,000,000 less for 1923 than for 1924.

"What Is a Contractor" to Be Subject of Prize Essay

In order to get the views of members of the proper relation among contractor, engineer and architect, the Associated General Contractors of America has invited essays on the functions of a general contractor, with the award of a prize of $100 for the best.

The questions asked, which are to be answered in the essays, are: "When is a contractor not a contractor; when is an architect or engineer a contractor; should the contractor hire architects, or vice versa; what lines should be drawn in regard to a contractor's functions?"

The essays must not exceed 500 words and must be in the hands of officials at the Washington headquarters of the Association before Dec. 31.

To Ballot on Road Builders' Revised Constitution

Ballots on the revision of the constitution and by-laws have been mailed to the members of the American Road Builders' Association. The revision is due to the dissatisfaction with the existing constitution and by-laws expressed at the last annual meeting. A revision committee was accordingly authorized. The chief changes are:

1. The transfer of the election of officers from the board of directors to the membership.
2. The nomination as an "official nomination," of only one candidate (instead of two, as now) for each directorship.
3. Provision for nominations by petition.
4. The transfer from the by-laws to the constitution of the sections relating to the election of officers, meetings, quorum and amendment of by-laws.

Ballots must be returned to the office of the association not later than Dec. 29.

Fletcher To Leave California Highway Commission

Austin B. Fletcher, chief engineer, California State Highway Commission and director of the California Department of Public Works, has filed his resignation with Governor Stephens to take effect before the first of the year. This action is the result of a change in the state administration which will take effect Jan. 8, when Governor Stephens will be replaced.

Mr. Fletcher has been chief engineer of the California State Highway Commission since its formation in 1911. Prior to that time he was connected with the Massachusetts Highway Commission. He has been director of the California Department of Public Works since it was created last year.

Water Famine in Mexico City Causes Riot and Deaths

Improper Gate Operation Floods Pumps Causing Shut-Down—15 Are Killed; 50 Hurt

Flooding of electrically-driven pumps on Nov. 26 caused a water famine in Mexico City, Mexico, which in turn led to a riot of several hours' duration in which 15 persons were killed and 50 were injured. A temporary pump was installed and on Dec. 1 the first of the disabled pumps was restored to service.

The water supply of Mexico City is obtained from springs near Xochimilco where four low-pressure pumping stations lift water into a concrete conduit leading to a high-pressure pumping station at Condesa where water is pumped to service reservoirs located at Molino del Ray and to the Mexico City mains. Two sluice gates are provided in the conduit about two kilometers from the Condesa pumping station towards Xochimilco. The gates control the level of water in the suction chamber of the Condesa pumps.

On Sunday, Nov. 26, the Condesa pumps shut down owing to surge on the conduit. Notwithstanding instructions issued to the operator to open gates wide he only opened them partially. The water level therefore rose in the suction chamber of the Condesa pumps and discharged through an overflow pipe into a drain leading to a sewer.

The drains of the transformer pockets are connected to the drain from the suction chamber. The discharge from the suction chamber backed up in the transformer pocket drains and flooded the pump house, partially submerging the pumps, which are horizontal, direct-connected to 3,000-volt synchronous motors. The motor windings were soaked.

The drying out of the motors had progressed sufficiently by Friday afternoon, Dec. 1, to make it possible to put the first pump back into service.

Soon after the flooding a small pump was installed at Condesa, pumping water from the suction chamber to furnish a small supply from fire hydrants, whence the population carried away water in buckets. Old private wells were also used.

A serious disturbance occurred on the evening of Thursday, Nov. 29, due to popular resentment over the water famine. Fifteen persons were killed and 50 injured in this riot.

Water Superintendent's Job in Oregon Given State Engineer

The office of state water superintendent in Oregon has been abolished according to advices from that state and has been combined with the office of state engineer. The change is to become effective Jan. 1, 1923. George Cochran is now water superintendent of the state and Percy Cuffer is state engineer.

Citizens Committee Reports on Pennsylvania Roads

Numerous Changes in Highway Policy Recommended by Body Headed by William H. Connell

The new administration that assumes the handling of Pennsylvania state affairs for the coming four years will make certain changes, it is believed, following the recommendations in the exhaustive report of William H. Connell, former chief engineer of the Philadelphia Bureau of Highways and now adviser to the Citizens Committee appointed by Governor-Elect Pinchot.

The Connell report, given to the members of the committee in an all-day session at Philadelphia recently, suggests numerous changes, all of which were adopted unanimously by the committee and given the approval of the governor and the governor-elect, who attended the meeting. The report of the Subcommittee on Highways was as follows:

In the state are 100,000 miles of public roads, excluding mileages in cities and boroughs of which 10,321 comprise the state system and are under the jurisdiction of the state highway department. Of this mileage 4,944 miles have some sort of hard surfacing and 5,377 are unimproved. There are 3,942 miles of roads in the primary system. The remaining 6,379 miles comprise the secondary system or the feeders to the main trunk-line roads.

Highway Expenditures

During the period from 1911 to 1923 about $50,000,000 were spent on maintenance, $123,000,000 on construction and about $18,000,000 on general miscellaneous expenses. This expenditure resulted in the construction or reconstruction of 3,150 miles of highways.

The total cost of improving and completing the highway system with an improved type of paving will be about $350,000,000. The report recommends the following policies for completion of the highway system:

1. Comprehensive highway transport survey so that plans can be formulated on an economic basis.
2. Standardization of right-of-way widths on both primary and secondary systems. Provisions should be made for eventually widening roads in their approach to large cities.
3. Condemnation of land as soon as possible for the ultimate highway systems.
4. Installation of a budget system insuring rigid control and economy.
5. Perfection of plans for financing the entire system of highways within a given time.
6. Legislative appropriations to insure federal aid.
7. Provision for the collection of motor license fees every two years instead of every year.
8. Discontinuance of the payment of labor by county highway superintendents.
10. Prohibition of political activity by employees of the highway department.
11. When detours cause general hardship, construct roads half their width, permitting public use of the half not under construction.
12. Important dirt roads should be oiled.
13. Name highways with appropriate titles wherever possible.
14. Information signs of historical interest to supplement present signs.
15. Extensive use of central markings on pavements to guide drivers.
16. Plan state work in four divisions under four divisional engineers.
17. Combine construction and maintenance divisions.
18. Standards of county superintendents of highways be raised to correspond to those in the engineering division.
20. Waterbound macadam roads that are heavily traveled should be resurfaced with bituminous penetration.
21. Priority should be given to widening and elimination of dangerous curves on heavily-traveled roads.
22. Super-elevate all curves.
23. Recommendations relative to the acceptance or rejection of bids should be made matters of public record immediately after every award.

W. E. Wood Is Killed in an Automobile Accident

W. E. Wood, prominent building contractor of Detroit and Flint, Mich., and president-elect of the Associated General Contractors of America, was instantly killed on Nov. 24 when the automobile in which he was driving alone skidded and overturned on the Dixie Highway about 15 miles north of Flint. Mr. Wood was on his way from Flint, where the W. E. Wood Co., of which he was president, has the contract for constructing a $1,500,000 high school building, to Saginaw.

Mr. Wood was born in Vincennes, Ind. in 1864 and began his career as a contractor in Flint. He was first connected with the Moses Construction Co. of Chicago, and later formed his own company. Besides erecting a number of the Buick and Chevrolet plants and school buildings in Flint, the W. E. Wood Co. has erected a number of the larger buildings in Detroit and other Michigan cities.

Besides being prominent in the affairs of the A. G. C., Mr. Wood was a member of the Detroit Athletic Club, Old Colony Club and the Detroit Golf Club.

Engineers Plan Banquet for New Italian Ambassador

A reception and banquet at which Prince Gelasio Caetani, the new Ambassador of Italy to the United States, will be guest of honor, is being planned by the Federated American Engineering Societies. L. W. Wallace, the executive secretary of the Federation has written Ambassador Caetani telling him of the desire of the engineers in this country to pay him this mark of respect. No information has been received as yet at the Italian Embassy as to the time of the new Ambassador's arrival. It is believed, however, that he will be in this country by the first of the year, in which case Mr. Wallace hopes to arrange to have Prince Caetani as the guest of honor at the annual banquet of Engineering Council.

Government Files Six More Cantonment Suits

Would Recover $29,000,000 From Builders of Travis, Lee, Custer, Pike, Dodge and Dix

Six additional suits against contractors who constructed army camps during the war were filed by the government Dec. 4. The first group of civil actions was instituted against cantonment builders Nov. 24, as reported in *Engineering News-Record* Nov. 30, p. 948. With the suits begun Dec. 4 the amount of money which the government seeks to recover from these eight cantonment constructors is brought up to $50,000,000.

The projects, contractors and sums involved in the six latest suits are:

Camp Travis, San Antonio, Tex., Stone & Webster, $3,000,000.

Camp Lee, Petersburg, Va., Rinehart & Dennis, Inc., $7,000,000.

Camp Custer, Battle Creek, Mich., Porter Bros., $5,000,000.

Camp Dodge, Des Moines, Ia., Charles Stewart & Co., Inc., $3,000,000.

Camp Dodge, Des Moines, Ia., Charles Wietz Sons, $4,500,000.

Camp Dix, Wrightstown, N. J., Irwin & Leighton, $6,500,000.

A suit involving the construction of one of the major New England camps was expected but the bill of complaint was apparently not completed in time to file with the others.

Complaints Filed Simultaneously

The six bills of complaint, practically identical in form, were filed simultaneously in federal district courts at San Antonio, Richmond, Detroit, Little Rock, Des Moines and Trenton. All charge connivance, fraud, waste and improper use of funds and material. As in the case of the four initial suits one of the specifications in the complaint filed Dec. 4 is the charge that contractors took advantage of the government's preoccupation in other matters to violate the confidence the government reposed in them.

According to official figures Camp Lee with one exception was the most costly of the cantonment projects. More than $18,000,000 was spent on Lee, $13,846,000 at Camp Custer; $11,296,000 at Dodge; $13,545,000 at Dix; $12,748,000 at Pike; and $9,880,000 at Travis. Camp Knox at Stithton, Ky., holds the high record in cost, $18,733,184 having been paid for its construction, according to the official figures.

Following the filing of suits on Dec. 4 an announcement was made by the Department of Justice officials that still more suits were to follow against contractors who built major wartime construction projects.

Interest Increases in Michigan Highway Short Course

According to word received from A. H. Blanchard, professor of highway engineering and highway transport, University of Michigan, extreme interest is expected in the highway engineering and highway transport short course to be held from December, 1922, to March, 1923. The attendance at these courses has increased during the past three years as follows: 1919-20, 29 men; 1920-21, 45 men; and 1921-22, 94 men.

Debate Rail Consolidations at I.C.C. Hearings

Hill Roads Oppose Commission Plan—Southern Pacific Would Retain Cenlral Pacific Lines

Two hearings now in progress before the Interstate Commerce Commission have developed much controversy over the proposal that the railroad systems of the country be consolidated into eighteen or twenty systems. One of these has to do with the northwestern roads, while the other touches the Southern Pacific and the Union Pacific Systems.

The commission's plan for grouping the northwestern roads has aroused strong opposition on the part of the Hill roads. Under the plan proposed, these would be separated, the Great Northern linked with the Chicago, Milwaukee & St. Paul and the Burlington and the Northern Pacific left in another group. The Colorado & Southern, now controlled by the Burlington, would be grouped with the Santa Fe.

In behalf of the Hill roads it is maintained that the Burlington, the Northern Pacific, and the Great Northern now have a strong community of interest built up through twenty years, and that the Burlington is in no way competitive with either the Northern Pacific or Great Northern. Practically all the freight handled by the Northern Pacific and the Great Northern is said to be competitive with other lines, such as the Chicago, Milwaukee & St. Paul, the Soo Line, the Chicago Northwestern, and the Union Pacific, so that by consolidating the Northern Pacific and the Great Northern with the Burlington, competition will still be protected without breaking up the existing Hill system.

In the course of his testimony, Hale Holden, president of the Burlington road, criticised the plan of the commission as based too largely on east and west traffic instead of giving due importance to the north and south traffic. He pointed to the great north and south lanes of traffic that are developing and that will continue to develop, and urged that this possibility be given due weight in planning the primary systems.

Southern Pacific Hearing

The hearing on the appeal of the Southern Pacific to retain control of the Central Pacific, despite the recent dissolution order by the Supreme Court, has developed sharp difference of opinion among the shippers and the communities interested. The railroad commissions of California and Nevada urge a continuance of the union between the companies, while those of Wyoming and Idaho urge approval of the separation.

Many shippers in California favor the strong California railroad system that is insured by the present union of the roads, and point to the havoc that would be worked on the Southern Pacific by the loss of the Central Pacific lines and branches. Others point to the traffic benefits that might be derived from an independent Central Pacific or one joined to the Union Pacific.

Some witnesses from Utah and Colorado favor the separation of the lines because of their belief that the Southern Pacific control of the Central Pacific property results in a diversion of transcontinental business over the lines of the former through El Paso rather than through their own states. Others fear a transportation monopoly by the Union Pacific and urge a continuation of the existing relationship.

Western Society Promotes Short Story Contest

"To encourage and develop the power of expression as a step toward making the members of the Western Society of Engineers more useful as dreamers, builders and leaders," a short (6,000 word) story contest has been initiated by that society. Prizes are to be offered for excellence in expression, humor and research. Contestants are to be divided into two classes, under and over 30 years of age. The society is to sell the successful papers and turn the proceeds over to the author.

For the purpose of encouraging versatility and increasing the popular interest, the first competition closing April 15, 1923 is to be for non-technical, popular stories built on a foundation of engineering facts. Full credit will be given for humor and the use of fiction when not in conflict with established facts. The writers are to be encouraged to discover or to create the story, romance and human interest that inspires every great venture.

Ohio Water Purification Men Adopt High Standards

Special Correspondence

Sixty-five water filtration plant superintendents and chemists from sixty-two cities and towns having water purification plants met in Columbus, Nov. 16-18 as the second Ohio Conference on Water Purification. Various problems connected with water treatment and water analysis were discussed and a rigid standard for the quality of filter effluents was adopted. It was shown at the conference that the majority of the filter plants in the state now have no difficulty in reaching the standard adopted by the conference, which is to the effect that all filter effluents *before chlorination* virtually equal the "Treasury standard" of 2 B. coli per 100 cc.

The discussions at the conference showed a recent trend toward water softening in Ohio. Three new water treatment plants in the state, those at Defiance, Delaware, and Newark, have incorporated softening with purification, and many other Ohio cities are considering doing the same.

Serious water shortage in various cities and villages in Ohio during 1922 was also brought out. The reserve supplies of Ashland, Blanchester, Jefferson and Washington C. H. are completely exhausted, while on Nov. 16 Columbus had only 26 days' supply in storage.

The presiding officer of the conference was J. W. Ellms of Cleveland. The chairman for the ensuing year will be Charles P. Hoover of Columbus. The next conference will be held in November, 1923—probably at Newark, Ohio, where an 8-m.g.d. water purification and softening plant is under way.

Howells-Hood Design Wins Chicago Tribune Building Prize

In the competition for architectural designs for the new building for the *Chicago Tribune* the first prize of $50,000 has been awarded to John Mead Howells and Raymond M. Hood, of New York. Under the terms of the competition they will be the architects for the structure. The second prize of $20,000 was awarded to Eliel Saarinen, of Helsingfors, Finland, in association with Dwight G. Wallace and Bertell Grenman, of Chicago. The third prize of $10,000 goes to Holabird & Roche, Chicago. The remainder of the $100,000 prize fund will be distributed among ten American architects who were invited to submit designs.

This new building is to be erected at 431 No. Michigan Ave., outside of the congested business district and just north of the Chicago River bridge, where it will be a very conspicuous structure. The building will occupy a site 100 x 135 ft. and will have a total height of 400 ft.

J. L. Harrington Installed as A.S.M.E. President

During its annual convention in New York City this week the American Society of Mechanical Engineers installed as its new president John Lyle Harrington, of the consulting engineering firm of Harrington, Howard & Ash, Kansas City, Mo.

Mr. Harrington was born in Lawrence, Kan., in 1868 and is an A.B., B.S. and C.E. of the University of Kansas. He has been designer for the Berlin Iron Bridge Co., assistant chief engineer of the Bucyrus Co., So. Milwaukee, Wis., assistant engineer of bridges and buildings for the Baltimore & Ohio R.R., and chief engineer and manager of the Locomotive & Machine Co. of Montreal. For three years he was executive engineer of the C. W. Hunt Co. of West New Brighton, N. Y.

In business for himself, he was first associated with J. A. L. Waddell of Kansas City. He is now with E. E. Howard and L. R. Ash.

Contract Let on Reaction Turbine for Record Head of 850 Ft.

The Portland Ry. Light & Power Co., of Portland, Ore., has awarded to the Pelton Water Wheel Co. contract for a 35,000-hp. reaction turbine to be delivered within 12 months for installation at the Oak Grove hydro-electric plant now being built on the Clackamas River. The new unit will be of the Francis type, designed for a head of 850 ft. It will operate at 514 r.p.m. and will have a specific speed of twenty-one. The Moody spreading draft tube will be used.

The world's record for high-head reaction turbines is now held by the Kern River No. 3 plant of the Southern California Edison Co. where two 25,000-kw. Francis turbines are operating under an 806-ft. head. The design of the Oak Grove unit will have the benefit of experience at Kern River No. 3 and will embody features of design of both the Pelton Water Wheel Co. and the I. P. Morris Department of the William Cramp & Sons Ship & Engine Building Co., recently consolidated with the Pelton company.

Forty-Eighth Annual Meeting of New Jersey Sanitarists Held

Among the fourteen papers read at the forty-eighth annual meeting of the New Jersey Sanitary Association at Lakewood, N. J., Dec. 1 and 2, were several dealing with engineering or related topics. In the course of his presidential address on "Municipal Zoning and Health" Dr. Charles V. Craster, health officer of Newark, gave as some of the benefits of zoning the better distribution of light, air and population. Dr. Haven Emerson, formerly health commissioner of New York City, in an outline of "The Nature and Purpose of a Health Survey," stated that the health officer should be the diagnostician of his community just as the private practitioner is of his individual patients.

A typhoid carrier was defined by Dr. Louis Harris, New York City health department, in discussing a paper on "The Use of a Laboratory in the Epidemiology of Typhoid Fever" by C. K. Blanchard, bateriologist, New Jersey Department of Health, as a person who, six months after having had typhoid fever excretes typhoid germs from time to time. Those excreting typhoid germs during the second three months after having had typhoid are called temporary carriers, while former typhoid patients up to three months are termed typhoid convalescents.

A fairer method of distributing construction costs between the communities included in the Elizabeth and Rahway Rivers Sewer District than is practiced in the Passaic Valley Sewerage District was mentioned by Alexander Potter, consulting engineer, New York City, as one reason why the former district has had its trunk outfall sewer in use so long (since 1902) that a supplementary sewer is now projected, while the Passaic Valley outlet is not yet completed. In the Passaic district the cost is distributed among the municipalities concerned in accordance with the assessed valuation of years back, which plan has caused opposition in some municipalities, while in the Elizabeth-Rahway district the distribution is based on the proportionate cost of the carrying capacity provided for each community.

The election of officers for 1922-23 resulted in the choice of Dr. E. J. Marsh, of Paterson, as president, and Chester G. Wigley (with Clyde Potts, consulting engineer, New York City) as chairman of the Executive Committee. Dr. Edward Guion, Atlantic City, N. J., was continued as secretary. The association voted to become an affiliate of the American Public Health Association.

Local Bodies Addressed by City Managers in Convention

Ninety-four delegates, most of whom were engineers, attended the convention of the City Managers' Association at Kansas City, Mo., Nov. 14 to 16—the best attended meeting of this organization since its inception. While the managers were in the city they addressed the Chamber of Commerce, City Club, Woman's Athenaeum, Woman's City Club, Rotary Club and Engineers' Club. The last-named tendered the managers a banquet and an excursion around the city, each automobile containing a local engineer as guide.

Hon. Henry Allen, governor of Kansas, in his address on "Municipal Government," stressed the shortcomings of the aldermanic form, the commission form and the city manager form of government, but held the manager form superior to anything yet tried.

"Modern Charters" was the title of an address by Prof. C. M. Fassett, of the department of municipal engineering, University of Kansas. He spoke of the present day tendency to shorten charters and eliminate partisanship in municipal elections. Professor Fassett was formerly mayor of Spokane, Wash, From his personal knowledge in that position he recalled the evils of political administrations and compared them with business administrations.

Municipal versus private onership of public utilities was debated by Delos Wilcox, New York City, on the affirmative, and Paul Haynes, of Indianapolis, on the negative. Mr. Wilcox criticized privately owned utilities, especially in their handling of refinancing, in which bond issue after bond issue has been pyramided without provision for payment. He compared this procedure with the programs of many cities where the utilities have been entirely paid for or where those that are not paid for have rates that will retire the entire bond issue before the expiration of the bonds. Mr. Haynes, who is an ex-member of the Indiana Public Utility Commission, deplored the socialistic tendencies of the day.

The newly elected officers are as follows: President, Louis Brownlow, Petersburg, Va.; vice-presidents, R. B. Rigsby, Durham, N. C., I. C. Brower, Pontiac, Mich., and C. W. Koiner, Pasadena, Calif.; secretary, John G. Stutz, Lawrence, Kan.

The Engineer in Public Life

WILLIAM B. POWELL

As chairman of its engineers and architects group and a member of its ways and means committee, William B. Powell, treasurer of the Industrial Planning Corp., engineers, has taken a prominent part in the activities of the Buffalo (N. Y.) Chamber of Commerce. During the recent revision of the city's building code Mr. Powell served on the committee which drafted the new regulations and recently he has been actively associated with the Buffalo City Planning Association. He has worked to decrease the number of motor accidents, and as a member of the National Safety Council is an advocate of safeguards for workers in factories.

Mr. Powell is a graduate of Stevens Institute of Technology, class of 1892, and has served on various committees of national engineering societies in their relations with the public. He has been a supporter of the movement to establish a national department of public works and was one of the organizers of the Federated American Engineering Societies.

Locomotive Blast Raises Bridge Planks; Police Close Structure

The effect of heavy blast from a locomotive in raising a few sidewalk planks in the Van Buren St. plate girder span over the tracks to the Chicago union station on Nov. 16 led a police officer to report the structure as dangerous and it was closed to traffic until inspection of the "accident." Although the structure is old it is in safe condition, but will be rebuilt next year in connection with improvements for the new union station.

Engineering Societies

Calendar

Annual Meetings

FEDERATED AMERICAN ENGINEERING SOCIETIES, Washington, D. C.; Annual meeting Washington, Jan. 11-12, 1923.

AMERICAN ROADBUILDERS ASSOCIATION, New York City; Annual Convention, Chicago, Jan. 15-18.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York City; Annual meeting, New York City, Jan. 17-18.

AMERICAN CONCRETE INSTITUTE, Detroit; Annual Convention, Cincinnati, Jan. 22-26.

ASSOCIATED GENERAL CONTRACTORS OF AMERICA, Washington, D. C.; Annual meeting Los Angeles, Jan. 30-Feb. 3.

The Western Society of Engineers was addressed Dec. 4 by Col. H. M. Byllesby, president, H. M. Byllesby & Co., on "Finance and Engineering." The Dec. 11 meeting will be a symposium on "Smoke Abatement," a subject the public affairs committee has actively promoted. E. H. Colpitts, assistant chief engineer, Western Electric Co., New York, will address the society Dec. 18 on "Research in the Art of Communication."

Personal Notes

GERALD L. FINCH has been elected county engineer of Garfield County, Wash., with headquarters at Pomeroy. At the time of his election he was a member of the engineering staff of the state highway department.

FRANK R. GOODMAN, of Flagstaff, county engineer of Coconino County, Arizona, has been selected by Governor-Elect Hunt of that state as state engineer for the incoming administration. Mr. Goodman has been prominent in highway work in Arizona during a large part of his 19 years' residence there, having served the state for several years as division engineer. Mr. Goodman will succeed THOMAS MADDOCK.

COL. F. G. JONAH, chief engineer of the St. Louis & San Francisco Ry., has been appointed assistant to the president. His appointment became effective on Dec. 1. Colonel Jonah's association with the Frisco road dates

From 1903 when he was appointed assistant engineer, having served earlier in his professional career as resident engineer for the St. Louis, Peoria and Northern Ry., engineer, maintenance-of-way, of the Chicago & Alton, and chief engineer of the Blackwell, Enid & Southwestern Ry. In 1913 Colonel Jonah was made chief engineer of the Frisco road, having served several years previously as chief engineer of construction of that and allied roads. He is a Canadian by birth and while studying engineering served with the Intercolonial Ry.

ROBERT H. HIGGINS, superintendent of maintenance of the Colorado Highway Department, having passed a civil service examination, has been retained in the permanent organization. His appointment was temporary, after the passage of the 1921 highway act, until such time as an examination could be held.

COL. W. G. ARN has been promoted from assistant engineer of maintenance-of-way, Illinois Central R.R., to assistant engineer of the Chicago terminal improvement, which improvement work is under an organization distinct from that of the general engineering department of the railroad. He entered the army early in 1917 and was in active service during the war, attaining the rank of lieutenant-colonel.

MAJ. L. D. BLAUVELT, appointed last year as state highway engineer of Colorado until such time as a civil service examination could be held, has been appointed permanently to that position. At the recent examination Major Blauvelt received the highest percentage among applicants for the position. Though the Colorado highway law of 1921, under which Major Blauvelt received initial appointment, places the appointment of the state highway engineer in the hands of the governor, that law is at variance with the state constitution which requires that all state employees other than specifically stated elective officers shall be under civil service.

ABRAM SWAN, JR., city engineer of streets, Trenton, N. J., is a candidate for the city commission at Trenton, N. J., Commissioner J. RIDGEWAY FELL has announced that he will retire. MR. FELL is also an engineer.

ERNEST PAFFRATH, an engineer in the department of streets and sewers of St. Louis, has been appointed superintendent of sewers of that city to fill the place made vacant two months ago by the death of WILLIAM CLANCY. WILLIAM J. DUGGAN, first assistant under Mr. Clancy, has been acting head of the department Mr. Paffrath now fills.

WILLIAM F. WILLIAMS, bridge engineer of the Massachusetts Department of Public Works, has been appointed by Governor Cox as head of that department to succeed the late JOHN N. COLE, whose death was announced in these pages recently. Mr. Williams has had wide engineering expreience. He served as city engineer of New Bedford, Mass., for almost 20 years, resigning that position in 1912 to become chief engineer of the state board of harbor and land commissioners. Several years later he entered the bridge department of the public works bureau. Mr. Williams was graduated from Columbia College with a C.E. degree in 1881 and an E.M. a year later. He followed mining in the West and South after graduation, becoming city land surveyor of New Bedford in 1893 and city engineer in 1895.

WILBUR S. SAMPLE, formerly manager of the Montreal, Can., office of the George A. Fuller Co., Ltd., has recently left for Dairen, Manchuria, to assume the duties of district manager of the George A. Fuller Co. of the Orient, Ltd., for that and other Chinese territory. Mr. Sample will direct the construction of a general hospital for the South Manchurian Ry. Co. at Dairen, together with additional construction work which is to follow both in that section and in Shanghai. WILLIAM OEHRLE is New York manager of the George A. Fuller Co. of the Orient, Ltd.

ARTHUR W. THOMPSON of Pittsburgh has been elected a director of the Pennsylvania R.R. to succeed the late THOMAS DEWITT CUYLER. Mr. Thompson is head of the Philadelphia Co. and subsidiary companies which furnish transit, electric light and gas in Pittsburgh and vicinity. He is a former vice-president in charge of operation and traffic of the Baltimore & Ohio R.R.

F. S. MCKAY, formerly a draftsman with the Duquesne Light Co., Pittsburgh, Pa., has become associated with the Chicago, North Shore & Milwaukee R.R. as office valuation engineer.

M. C. KENNEDY, until recently in the employ of the Texas, Oklahoma & Eastern R.R. as assistant engineer and stationed at DeQueen, Ark., has become associated with the engineering department of the Pennsylvania R.R. He is attached to the assistant chief engineer's office in the construction department and stationed at Beaver Falls, Pa.

M. L. TIEFENBRUN, who for the past twelve years has been a structural engineer and highway engineer and lately connected with railroad valuation, has established offices in Asbury Park, N. J., where he will give special attention to the design of steel and concrete structures, municipal work, valuation and surveys.

DR. ELWOOD MEAD has resigned as chief of the division of land settlement, California State Department of Public Works, to take effect Jan. 1. As reasons for his resignation Dr. Mead states that the defeat of the land settlement bond issue makes it at least doubtful whether any new settlements are to be created in the near future, and the two developments already started are practically completed. By relinquishing charge of the land settlement division Dr. Mead expects to gain time for researches in rural organizations to which he plans to devote attention in connection with his work as professor of rural institutions at the University of California.

THE UNION CONSTRUCTION CO., Oakland, Calif., engineering contractors, have opened offices in the Van Nuys Bldg., Los Angeles, to handle contracts in the southern section of the state.

J. J. MCCARTHY of Tekoa, Wash., has been made road engineer for the fourth division of the Oregon-Washington Railroad & Navigation Co., taking the place recently made vacant by the death of J. J. LAWLER.

ERNEST R. CHILDS, who was a captain of engineers during the World War, has been elected county surveyor of San Diego County, Calif., succeeding GEORGE BUTLER. He will take office Jan. 1.

MAJOR GEORGE M. RICE has been appointed superintendent of streets for Seattle, Wash., to succeed MAJOR OSCAR H. PIPER. Major Rice served overseas with a railway engineering regiment. He was formerly chief engineer of construction for the Copper River and Northwestern Ry., and was for a time with the Northern Pacific and the White Pass & Yukon railroads.

C. W. WOOD, chief engineer for the South San Joaquin Irrigation District, Manteca, Calif., has tendered his resignation, effective Jan. 1, 1923.

F. W. MCCARTON, formerly assistant engineer with the Modesto Irrigation District, has been appointed city engineer of Modesto, Calif., to succeed GEORGE FREITAS, resigned.

OBITUARY

GEORGE DICKSON, former city engineer of Alton, Ill., died in that city Nov. 25, aged 74 years. He also served as Madison County engineer for eight years.

WILLIAM DOUGLAS, president and general manager of the William Douglas Co., contractors of Providence, R. I., died in that city, Nov. 26, aged 83 years.

JOHN J. MURRAY, who for almost thirty years was employed as civil engineer in the Boston city engineering department, died in that city recently, aged 45 years. Mr. Murray had been with the city since his graduation from Somerville, Mass., High School.

ZAC T. DUVALL, a civil engineer who had practiced his profession in Denver, Colo., died recently, aged 69 years. Mr. Duvall was born in Missouri but went to Denver when 13 years of age, spending most of his life there. Some of the important work engaged in by him were: The construction of Cheesman dam, the largest contributor to Denver's water supply; the Amity canal at Lamar, Colo., and railroad work through the Royal Gorge near Canon City.

From the Manufacturer's Point of View

A Point of Contact Between Maker and User of Construction Equipment and Materials

COMING from the accredited spokesman of the cast-iron pipe industry, Mr. Wolfe's announcement on this page of a policy whereby both maker and user of pipe will share in economies effected by winter purchases has a large significance for water-works engineers, city officials, and other users of pipe on public and private works. Mr. Wolfe, it should be noted, speaks for eight of the leading cast-iron pipe manufacturers, including the American Cast Iron Pipe Co., Lynchburg Foundry Co., James G. Clow & Sons, National Cast Iron Pipe Co., Donaldson Iron Co., U. S. Cast Iron Pipe & Foundry Co., Glamorgan Pipe & Foundry Co., and Warren Foundry & Machine Co.

The arguments for spreading the buying of pipe over the entire year, instead of concentrating it in the summer months, were presented by "Engineering News-Record" in its issue of Oct. 19, 1922, p. 675. Succeeding issues carried a comprehensive discussion from the pipe user's point of view, in which a dozen of the country's leading water-works engineers participated.

The evidence has been presented—it now rests with the purchasers of pipe, individually and through their organizations such as the American and the New England Water Works Associations, to take action on a program which will make possible the economies indicated.—Editor.

Pipe Buyers Will Share in Savings Effected by Winter Buying, Manufacturers Pledge

Industry's Spokesman Concludes Discussion Initiated by "Engineering News-Record" by Announcing Policy Benefiting Both Maker and User

By Thomas F. Wolfe
Secretary, Cast-Iron Pipe Publicity Bureau, Chicago

FROM the opinions expressed by the water-works men who have taken part in the discussion on the "Winter Buying of Pipe" in *Engineering News-Record* during the past few weeks it appears that the buyers and sellers of pipe agree both as to the advisability as well as the feasibility of doing business in this way. Some objections were raised, many of which were local in character or affected only certain phases of pipe-laying, and many new arguments in favor of all-year buying were brought out. The one point of common interest is the matter of price.

The cost of cast-iron pipe is made up of several factors: First, cost of pig-iron, coke, hay, and other supplies; second, cost of conversion; third, transportation charges; fourth, overhead; and fifth, profit. Of these items the only ones that can be controlled by the makers is the conversion cost, the overhead and the profit. The remaining factors are fixed by conditions outside the pipe industry and represent the greater part of the final cost of pipe. Any effort, therefore, on the part of manufacturers to reduce the cost of pipe must be along the line of economies that lower the factors of production and overhead costs and profit.

Winter Production Lowers Costs

The desire on the part of the pipe-makers to make and sell pipe on a basis that would keep the shops going at a fairly even rate throughout the year is prompted solely by their desire to bring about these savings. Winter buying of necessity must lower production and overhead cost, since annual charges are evenly distributed and there would be no slack-period charges to be borne by the product of a few months' operation. The efficiency of individual laborers is improved and costly labor turnovers lessened. The savings made in conversion costs and overhead expenses will lower the cost of pipe produced throughout the entire twelve months of the year.

Manufacturers have always been glad to accept winter orders at a lower figure than pipe would bring during the summer, assuming pig-iron costs were the same. During the past 17 years there were only 5 years when the summer cost of pipe was lower than the winter cost, and this in spite of the fact that no concerted effort was made to encourage winter buying. The pipe makers have gone even further along the line of lower prices—in addition to the saving made in manufacturing costs part of the profit has been cut off during the winter months. These factors are attested by the experience of those who, in the past, have been able to place orders in the winter. The proportionate saving will be even greater when this practice becomes more generally adopted.

Many arguments against winter purchase are offset by the advantages gained. It is true that in some of the northern parts of the country it is practically impossible to lay pipe in the winter. On the other hand, many contractors in the colder sections have clamored for early delivery, so that they could take advantage of the comparatively short construction season and get a maximum amount of work done. The purchase and delivery of pipe during the winter will help not only contractors in these sections, but also municipalities where work absolutely must be done on some kind of a schedule during their short construction season. A better class of labor can usually be procured for hauling and stringing the pipe during this season and better teaming prices should prevail during the slack period.

Temporary Storage Possible

Large pipe, of course, cannot be strung along busy city streets, but pipe for cross-country lines can best be delivered when the ground is frozen, and as a rule it is not a nuisance to any one. Smaller pipe placed in the parkway of outlying streets during the winter months is not usually considered objectionable by the fronting property owners. Temporary storage in vacant lots along the proposed pipe line has been found economical in some places. The cost of rehandling pipe is a factor that probably would be offset by the saving in first cost and even where this is not the case the advantage of a sure supply of material should be considered as a real economy. During the recent railroad strike, many pipe buyers begged for early delivery and were willing to pay a premium if this could have been brought about. The purchase of pipe in the winter would insure better deliveries of pipe in summer as well as winter.

The main issue in the winter buying program resolves itself into whether or not it is an economical practice. The manufacturers believe that it is and conceived the idea of promoting winter purchases with the thought in mind of passing on to the buyers the results of this more efficient production basis. They realize that if winter buying is to be encouraged, the buyer must profit. Confidence in the manufacturers whose interests are as much at stake as the pipe buyers' should bring about the adoption of all-year pipe buying and the result will be economy for all concerned.

Points in Policy of Pipe Makers

The one point of common interest is the matter of price.

Winter buying must lower production and overhead costs.

The manufacturers realize that if winter buying is to be encouraged the buyer must profit.

The policy of cast-iron pipe manufacturers will be to pass on to the buyer the saving in production costs resulting from winter buying.

Beginning in Next Week's Issue

A discussion of "Better Equipment Maintenance and Repair Parts Service."

Suggestions by manufacturers for contractors.

Orders for repair parts often omit necessary information.

A recital of actual experiences, showing possibilities of cooperation between user and maker of construction plant.

New Guide for Business with Latin America

Social Amenities Important, Says U. S. Commerce Department's Book, Just Published

WHEN a commercial traveler goes to Latin America he should take his dress clothes and frock coat with him as indispensable accessories to the carrying on of business, according to Ernst B. Filsinger in the new edition of the "Commercial Travelers' Guide to Latin America," just released by the U. S. Department of Commerce. The social amenities, it is pointed out, are strictly observed by our southern neighbors, and business and social activities are intermingled and blended in a manner inconceivable to the average American business man. The observance of customs such as the sending of appropriate greetings to customers on New Year's, the presentation of little gifts and novelties by commercial travelers' are more widespread and far more necessary than in the United States.

Holidays are numerous in all the Latin American countries and in mapping out itineraries they should be taken into consideration. Crops and seasons play an important part; the most profitable month to go to Costa Rica is April when the coffee comes to bearing, and the most agreeable month to visit Honduras is February, says Mr. Filsinger. These and countless other suggestions and facts are contained in this commercial "Baedeker" of Latin America.

Facts About 20 Republics

Everything a commercial traveler ought to know about the twenty republics and the many colonies to the south of us to make a trip profitable as well as enjoyable is encompassed within the 734 pages of the new government publication; steamship lines and railroads, time tables and connections, road routes, hotels and rates, taxes on travelers and restrictions, duties on samples and advertising matter. The traveler is told about the banks, postal service and postal rates, weights and measures, and all things that may obviate those vexatious delays which are especially troublesome to the uninformed and inexperienced traveler in Latin America.

Every city and market of importance in the Latin Americas is listed with information as to its characteristics, trade regulations, license fees, routes by which to reach it, etc., and the traveler is given abundant advice for canvassing each section.

This publication is quite a departure from the usual routine of official bulletins. Its attractive format — the standard guide book size with stout flexible covers, thin paper, and convenient paragraph headings—is a feature. One of the most important items in the guide is the series of more than 40 maps which were specially drawn for this publication and are based upon the most recent authentic data regarding railway lines, commercial centers, etc. The guide may be obtained at a cost of $1.25 by applying to the Superintendent of Documents, Government Printing Office, Washington D. C., or to any of the District or Co-operative offices of the Bureau of Foreign and Domestic Commerce.

To Picture Story of Steel

"The Story of Steel," a six-reel motion picture, will be shown by the Iron League of New York in the Engineering Societies' Building, 29 West 39th St., New York City, at 8 p.m., Dec. 13.

Economy and Efficiency in Plant Selection

From an address by Brig.-Gen. R. C. Marshall, Jr., general manager, Associated General Contractors; before the New York State Industrial Conference at Buffalo, Nov. 22, 1922.

IN ADOPTING a suitable layout of plant and procedure for building a highway or any other type of project, one of the first problems of the construction company is to decide upon the most economical method of construction. This is not purely a study in job mechanics and engineering, but is also a study in economics. It requires a decision as to whether the company should purchase special equipment, or execute the work with equipment on hand; and if special equipment is advisable, how much of its expense the low bid can stand and how much the equipment will bring in salvage. If, as is commonly presumed, the most efficient method were always the most economical the problem would be simple—a question in job mechanics; but since this is not the case, the real problem is to determine whether the most efficient method will in the end prove the most economical. . . . In China the most economical manner of transporting road-building material is frequently on the head of a cooley. This is obviously not an efficient method, but in that particular locality is the one which would deliver the owner's project at a minimum cost. In Illinois, where materials are delivered by motor truck and industrial railway, we find the method that is both very efficient and very economical for that locality.

Salesmen Study Lumber at Forest Products Laboratory

A group of short courses given at the Forest Products Laboratory of the Department of Agriculture to lumber salesmen was so successful that further courses will be given in January. The object of these courses is to present through lectures and demonstrations technical information on the structure, shrinkage, strength, durability, seasoning, and grading of lumber.

Coffin Foundation Created by General Electric Co.

Income from $400,000 to Be Used as Reward for Service in Electrical Field

BY ACTION of its board of directors, the General Electric Co. has set aside a fund of $400,000 to be known as the Charles A. Coffin Foundation, the income from which, amounting to approximately $20,000 per year, will be available for encouraging and rewarding service in the electrical field by giving prizes to its employes, recognition to lighting, power and railway companies for improvement in services to the public and fellowships to graduate students and funds for research work at technical schools and colleges. Mr. Coffin has been identified with the development of the electrical industry since 1882. He was the founder and creator of the General Electric Co., of which he was the inspiration and leader for thirty years until his retirement on May 16 in his 78th year.

The foundation will be controlled and administered by a Foundation Committee, appointed by the board, which will distribute the income of the foundation.

Power and Mechanical Exposition to Be Held in New York

Arrangements have been completed for holding the National Exposition of Power and Mechanical Engineering at the Grand Central Palace, New York City, Dec. 7-13.

Business Notes

AIR REDUCTION SALES CO. has discontinued its offices at 120 Broadway and 160 Fifth Ave. and consolidated them at the new address, 342 Madison Ave., New York City.

DERRICK & HOIST CONSTRUCTION CO., INC., New York, engineers and contractors specializing in sand, coal and stone-handling plants, has arranged to continue the business of William J. Haskins, consulting engineer for material-handling equipment, who died recently. The Derrick & Hoist Construction Co. has taken over Mr. Haskins' drawings and other records and is prepared to make alterations or repairs to plants which he built.

UNDERWRITERS' LABORATORIES has removed its New York office from 25 City Hall Place to the Union Laboratories Building, 109 Leonard St. At the new location will be continued the work of the electrical testing laboratory, the planning of inspections at factories and label service in the metropolitan district, New York State, New Jersey, and southern Connecticut.

WILSON WELDER & METALS CO. is now represented exclusively in Maryland, Virginia and the District of Columbia by the Alexander Milburn Co. of Baltimore. A stock of color-tipt welding metals and plastic-arc welding machines is available at this point for

distribution throughout the territory and a demonstration plant is in operation.

HARDWOOD MANUFACTURERS' INSTITUTE, Memphis, Tenn., has announced the appointment of Roy H. Jones as assistant to J. M. Pritchard, secretary-manager. Mr. Jones, who has been with the Department of Commerce in Washington as assistant to Axel H. Oxholm, chief of the Lumber Division, since that division was established by Mr. Hoover, is a practical lumberman of wide experience.

STANDARD TURBINE CORP., New York City, manufacturing steam turbines, announces the appointment of E. E. Maher as district sales manager in Chicago, with offices at 2237 Insurance Exchange Building.

A. E. JONES, sales engineer in the New York office of the Terry Steam Turbine Co., has accepted a position with W. B. Connor, Inc., N. Y. City, in a similar capacity. Mr. Jones will assume his new duties Jan. 1.

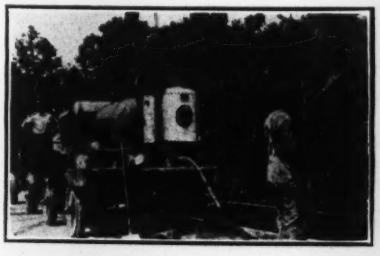
BERNARD L. MCNULTY, general manager of the Lehigh Lime Co., has been elected president of the Marblehead Lime Co., with offices in Chicago.

GIBB INSTRUMENT CO., Detroit, manufacturer of electric welding equipment, announces the removal of its plant and offices to Bay City, Mich., effective Dec. 1. The purpose of this move is to provide increased manufacturing facilities. For the past two years this company has concentrated on the development of automatic and semi-automatic arc, spot and seam welders.

Equipment and Materials

Portable Sand-Blast Outfit for Cleaning Steel Bridges

A combination compressor and sand-blast outfit mounted on a motor truck for mobility is manufactured by the Pangborn Corp., Hagerstown, Md., for cleaning bridges, buildings and other

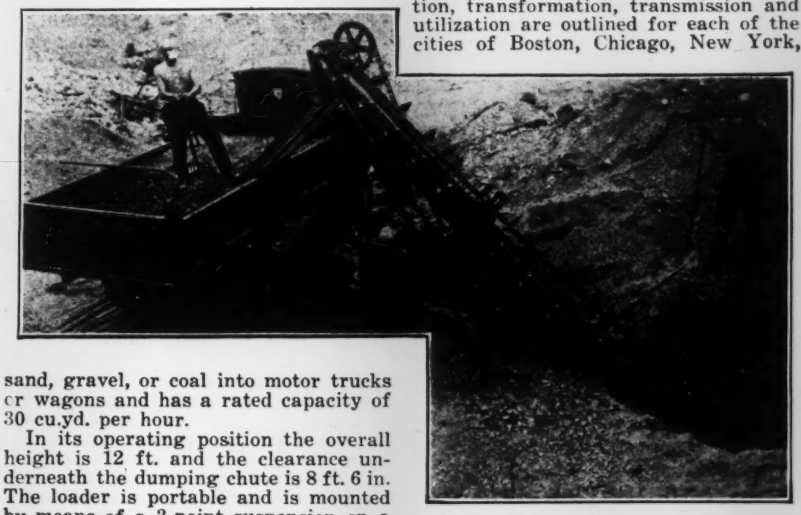


structures. In repainting structural bridges the permanence of the protective coating, it is pointed out, is dependent in a great measure upon the condition of the surface when the paint is applied. Sand-blasting is claimed to be the best means of preparing the surface by removing rust, scale, old paint or foreign material, and exposing the metal. In addition, the surface is slightly roughened or pitted, depending upon the size of the abrasive used, thus providing an additional hold for the paint.

With the mobile outfit illustrated county bridges over a wide range of territory can be sand-blasted. This means of cleaning bridges is in use by the state highway commissions of Ohio, North Carolina, and California. The sand-blast cleans from 2 to 4 sq.ft. per minute.

Scraper-Plate Wagon Loader Has Self-Feeding Arm

A self-feeding arm hinged at the base of the elevator frame is one of the features of the wagon loader manufactured by the N. P. Nelson Iron Works, Inc., Brooklyn, N. Y. The device consists of a 13-ft. inclined steel trough up which material is moved by 5x14-in. scraper plates on an endless chain operated by either a 5-hp. gasoline engine or a 3-hp. electric motor. The equipment is designed for loading



sand, gravel, or coal into motor trucks or wagons and has a rated capacity of 30 cu.yd. per hour.

In its operating position the overall height is 12 ft. and the clearance underneath the dumping chute is 8 ft. 6 in. The loader is portable and is mounted by means of a 3-point suspension on a four-wheeled chassis, as shown in the accompanying illustration. The elevator arm is raised and held in any position by a hand wheel, and, when moving from one job to another, is brought to a horizontal position in which its height above the ground is 6 ft. 3 in. The weight of the Type A (gasoline engine) unit is 1,800 lb. and of the type B unit (electric motor) 2,000 lb. The drive is by reduction gears in the case of the gasoline engine type and by Diamond roller chain in the case of the electric motor type.

In the illustration the shaft of the chain guide wheel at the foot of the loader trough rests in vertical guide slots which allow the wheel to rise when large or odd shaped pieces of material enter the trough. This feature prevents strain on the conveyor chain and scraper plates.

Dry Batteries for Blasting

For small-scale blasting operations the National Carbon Co., Inc., is advocating the use of its Columbia dry batteries; for this purpose the new steel case hot shot battery has been developed. In its suggestions for the use of this battery for blast firing the company states that the blasting caps should be connected in parallel across the line instead of in series as is customary with the generator method. A No. 6 dry cell will fire eight caps simultaneously. For each 100 ft. of wire, counting both sides of the line, one dry battery in series should be added to the original cell. It is advisable from the safety standpoint to connect two ordinary push buttons, one on each side of the line, with the wires of the circuit. When ready to fire, both buttons are pressed at once.

Publications from the Construction Industry

Subway Systems—GENERAL ELECTRIC Co., Schenectady, N. Y., has just published an illustrated pamphlet describing the more important of the country's rapid-transit systems from an electrical engineering point of view. The facilities for power production, transformation, transmission and utilization are outlined for each of the cities of Boston, Chicago, New York, and Philadelphia. Small maps showing the locations of the lines are included. No attempt is made to comment on the civil engineering features of the several projects, the text being confined to electric power problems.

Portable Electric Tools—BLACK & DECKER MANUFACTURING CO., Baltimore, in a 31-p. illustrated catalog, features its line of portable electric tools, including drills, grinders, screw drivers, and air compressors. Various models of portable electric drills have a pistol grip and trigger switch, enabling the operator to control the tool like an automatic pistol. Two pages are devoted to an explanation of the best method for grinding drill bits.

Copper Steel—AMERICAN SHEET & TIN PLATE CO., Pittsburgh, has published a 14-p. illustrated pamphlet entitled "The Testimony of a Decade," which presents service records indicating the rust-resisting qualities of its Keystone copper steel in comparison with sheets and plates of other compositions. Galvanized sheets of copper steel are recommended for culverts, tanks, bins, flumes, roofing, sidings, gutters, ventilators, and skylights. Terne plates of the same material are applicable to roofing where durability and fireproof qualities are desired.

Business Side of Construction

Facts and Events that Affect Cost and Volume

November Contracts 11 Per Cent Heavier Than in 1921

About 22 per Cent Under Lettings For October—Gains In Bridges and Commercial Buildings

Lettings in the United States and Canada on important engineering construction projects, as announced in the five November issues of *Engineering News-Record*, aggregate $134,697,000, compared with $137,877,000 reported in the four October issues. This represents a weekly average of $26,939,400 for November as against $34,469,250 during October. Awards for November, 1921, totaled $96,635,000, an average weekly rate of $24,158,750 or about 11 per cent under the value of contracts let during November of this year.

Minimum costs observed in Construction News, on each class of construction, are as follows: Water-works, $15,000; other public works, $25,000; industrial construction, $40,000 and commercial buildings, $150,000.

The weekly average for bridge construction during November was $1,351,800 as against $474,750, the weekly rate for October. Commercial buildings averaged $14,383,800 and miscellaneous construction, $975,800 weekly, compared with $13,953,500 and $830,500, respectively, for the two classifications during October.

Lettings in the Middle Atlantic States exceeded the totals for the Middle West by over $11,000,000. Only in three instances have the Middle Western states surpassed the Middle Atlantic group, in total values of contracts let, since the beginning of the year.

Bids Wanted on Big Jobs

Among the projects on which bids are either asked or will soon be called for, in Construction News, pp. 291 to 304, are the following:

High school, Kansas City, Mo., for Board of Education, $1,400,000.

Annex to State Capitol, Nashville, Tenn., for State, County and City, $1,400,000.

Apartment, New York, N. Y., for S. & L. Building Corporation, $1,200,000.

School building, Trenton, N. J., for Board of Education, $1,000,000.

Two school buildings, New York, N. Y., for Board of Education, $1,000,000 and $1,750,000, respectively.

Large Contracts Let During Week

Among the week's announcements of contracts awarded in Construction News, pp. 291 to 304, are the following large projects:

Bank and office building, Chicago, Ill., to Thompson-Starrett Construction Co., $7,000,000.

Office building, Boston, Mass., to G. A. Fuller Co., $3,000,000.

Factory, Kansas City, Mo., to Frank Hill Smith, Inc., Dayton, O., $1,250,000.

Store, Atlanta, Ga., to Selden Breck Construction Co., $1,250,000.

Hotel, Chicago, Ill., to F. A. Siebold, Jr.. $1,200,000.

Apartment, Cleveland, O., to W. Dunbar Co., $1,000,000.

Hotel, Hamilton, Bermuda, to J. Stewart Co., 30 Church St., New York, N. Y., $1,000,000.

Rapid-Fire Survey of Business Conditions

Transportation situation remains an important factor in retarding business. Loadings for the week of Nov. 18 were 178,731 cars heavier than a year ago, but the volume of railway business will probably decline in December.

Labor is another prime factor and is carefully considered on p. 999 of this section. *Engineering News-Record's* figures show the average hourly rate paid common labor in eighteen cities up 2c. during November.

Money on demand ruled between 4 and 5½ per cent, the same as the previous week, in New York. Time money rate continued at 5 per cent, with borrowers reluctant to pay it, resulting in a small volume of business.

(*Continued on p. 999*)

Engineering News-Record Construction Cost Index Number

December, 1922	**192.60**
November, 1922	188.60
December, 1921	167.82
Peak, June, 1920	273.80
1913	100.00

Engineering News-Record's Construction Cost Index Number advanced four points since last month, due to rise in average common labor rate. Steel is still $2.00 per 100 lb., Pittsburgh mill. The average rate for common labor is now 47c. Thus, general construction cost is 14 per cent higher than one year ago and 30 per cent under the peak; it is 92.6 per cent above the 1913 level.

Engineering News-Record Construction Volume Index Number

Monthly	
November, 1922 (*5 issues of E. N.-R.*)	122
October, 1922 (*4 issues of E. N.-R.*)	127
November, 1921 (*4 issues of E. N.-R.*)	101
1913	100
Yearly	
1921 (entire year)	88
1920 (entire year)	91
1913	100

Engineering News-Record's Construction Volume Index Number is 122 for the month of November, and 88 for the whole of 1921, as against 100 for 1913. This means that the actual volume of construction in 1921 (not the mere money-value of the contracts let that year) is 12 per cent under the volume of construction for 1913. Our monthly volume number, 122 for November, 1922, is really the increment of construction, and indicates the rate at which contracts are being let as compared with 1913 awards.

VALUE OF CONTRACTS LET IN THE UNITED STATES AND CANADA IN NOVEMBER, 1922

	New England	Middle Atlantic	Southern	Middle West	West of Mississippi	Western	Canada	Total
Waterworks	$16,000	$1,185,000	$39,000	$520,000	$287,000	$114,000	.....	$2,161,000
Sewers	105,000	243,000	89,000	2,442,000	2,135,000	242,000	$113,000	5,369,000
Bridges	30,000	3,111,000	2,265,000	372,000	575,000	97,000	259,000	6,709,000
Excavation, drainage and irrigation	.....	.....	881,000	252,000	583,000	25,000	.....	1,741,000
Streets and roads	238,000	2,600,000	7,531,000	899,000	7,068,000	2,163,000	393,000	20,892,000
Industrial works	2,045,000	5,509,000	688,000	4,392,000	1,993,000	1,018,000	2,934,000	18,579,000
Buildings	5,101,000	27,610,000	4,520,000	19,651,000	8,506,000	5,418,000	1,113,000	71,919,000
Federal Government	28,000	251,000	145,000	1,623,000	203,000	198,000	.....	2,448,000
Miscellaneous	84,000	1,006,000	677,000	281,000	192,000	438,000	2,201,000	4,879,000
Total	$7,647,000	$41,515,000	$16,835,000	$30,432,000	$21,542,000	$9,713,000	$7,013,000	$134,697,000

(*Continued from p. 998*)

"Conservative first mortgage loans on improved real estate have invariably proved the most satisfactory form of investment," says Harold W. Watson, a mortgage specialist, as quoted in the New York Times, "and during the construction and reconstruction period of the last four or five years we know that money has been in great demand at rates 6 per cent and more, while in some states an 8 per cent rate is considered reasonable. There is every indication that the interest rate of 6 per cent, which has held up for several years in Greater New York, has more or less settled down to a 5 per cent basis in Manhattan."

Stock market has shown an interesting feature recently, in its lack of response to favorable news. The Annalist asserts that stock dividends have lost their influence as a market factor, as have reports of good business and large crops. This indicates real dullness, particularly as money for stock market requirements is plentiful. Reasons are not difficult to find: Europe, the railroads, possible legislation in the next two years, fear of increased taxation. The Annalist concludes: "In the meantime not a few holders of securities who bought for the rise may take their profits and sell, and those who were not fortunate

Labor Rates and Conditions Throughout the Country

That industrial conditions are steadily improving has remained undisputed, among generally accepted economic authorities, since the recent depression. But wide differences of opinion seem to prevail regarding the labor supply. Reports received by the National Industrial Conference Board, from the U. S. Department of Labor, state that in 355 industrial centers an increase in employment was noted in twelve of the fourteen industrial groups. According to a survey conducted by the American Federation of Labor, reports of a labor shortage in this country are greatly over-estimated. A comparison of excerpts, taken from the respective reports of the two industrial authorities, for the same five cities, proves interesting.

Local industrial conditions as reported by *News-Record* correspondents are given as follows:

Atlanta—Building continues active, with fairly good supply of labor.

Birmingham—Common labor sufficient but not abundant; awarded advance of 5c. per hour.

Boston—Just about enough bricklayers, carpenters and hodcarriers, but not all piledrivers and structural ironworkers employed. Plenty of hoisting engineers, but scarcity of good common laborers.

Cincinnati—Bricklayers scarce; labor supply normal, otherwise.

Dallas—Plenty of common laborers; hod carriers fairly plentiful, but limited supply of skilled crafts.

Denver—All trades, 100 per cent employed.

AMERICAN FEDERATION REPORT

Milwaukee, Wis. "There is no industry here that has a shortage of labor."

Youngstown, Ohio. "This central body reports that steel mills cry labor shortage and force men to undergo a physical examination. Low wages, which make it impossible to live, is the rule. Men appear at the factory gates but are not employed."

Detroit, Mich. "There is a line-up in front of every employment agency in the city. The mission houses are full. More men are seeking employment at local factories than can be used by them. There is a big over-supply of common labor and considerable of a surplus of skilled workers in Detroit."

Kenosha, Wis. "There is unemployment galore and we expect same to be much worse—a month from now."

Pittsburgh, Pa. "There is no material labor shortage." "This letter states that steel mills shortage is because men refuse to work long hours for low wages. Men are being brought from South, but do not stay."

DEPARTMENT OF LABOR REPORT

Milwaukee, Wis. "Upward trend in employment. Shortage of workers in building trades, machinery and textiles. . . ."

Youngstown, Ohio. "Gradual increase in employment. Shortage of common labor exists, especially in the steel mills. Surplus of helpers, handymen and clerical workers. Demand for farm help fair. . . ."

Detroit, Mich. "Employment in industries decidedly improved. Slight shortage of brick masons; no surplus in any lines. . . . Building operations steady. Public improvements increasing. Housing in Detroit not equal to demand."

Kenosha, Wis. "Increase in employment. Shortage of common labor. All plants operating, majority full time."

Pittsburgh, Pa., District. "Demand for mechanics, with the exception of bricklayers and painters, is still in excess of the supply. . . . Iron and steel industry is steadily increasing employment. . . . An acute shortage of common labor persists, mills, factories and construction work making strong demands."

Kansas City—Shortage of bricklayers, hodcarriers and carpenters; other trades plentiful.

Montreal—Scarcity of bricklayers only.

New Orleans—Fair supply of labor.

New York—Armistice declared in dispute between the two building laborers' helpers' unions. The Interstate Union men had refused to use materials handled by members of the Independent Union, which had in turn been sponsored by the employers. Lockwood committee, acting as arbitrator, adjourned until Dec. 12, pending permanent settlement.

St. Louis—Common laborers paid 35c.@45c. as compared with 30c.@40c. per hr., one month ago.

San Francisco—Plenty of work for all trades.

Philadelphia—Demand for labor easing up perceptibly.

(Higher rates indicated by +, decreases by—)

Cities	Bricklayers	Carpenters	Hoisting Engineers	Hod Carriers	Pile Drivers	Structural Iron Workers	Common Labor
Atlanta	$0.90	$0.70	$0.70	$0.30	.....	$0.65	$0.30@.35
Baltimore	1.25	.80	.87½@.90	.60@.75	$0.75	1.00	.35@.40
Birmingham	1.00	.75	.50@1.00	.15@.25	.....	1.00	+.20@.25
Boston	+1.25	1.00	90@1.00	.75@.80	1.00	1.00	.50@.55
Cincinnati	+1.35	.95	.95	.72½	.....	.95	+.35@.40
Chicago	1.10	1.00	1.10	.....	1.10	1.05	.72½
Cleveland	1.25	1.10	1.10	.75	.91	1.10	+.75
Dallas	+1.37½	1.00	1.00	—.40	—.87½	1.00	+.30@.50
Denver	1.25	1.00	1.00	.75@.81¼	1.00	1.03⅛	.35@.50
Detroit	1.12½	.80	.80@.90	.50@.60	1.00	.60@.80	.50
Kansas City	1.12½	1.00	1.00	+.80	1.00	+1.07½	+.40@.50
Los Angeles	1.25	1.00	1.00	1.12½	.87½	1.00	.56¼@.62½
Minneapolis	1.00	.80	.80	.65	.....	.80	.35@.50
Montreal	.90	.65	.50	.35	.50	+.65	.30@.35
New Orleans	1.00	.85	.90	+.65	.80	1.00	.35@.40
New York	1.25	1.12½	1.25	.87½	1.00	1.12½	.45@.60
Pittsburgh	1.30	1.12½	1.00	.90	1.00	1.00	.50
St. Louis	1.25	1.10	1.12½	.85	1.12	1.12½	+.35@.45
San Francisco	1.12½	1.00	1.00	.75	1.00	1.12½	.47½@.50
Seattle	1.00	.80	.90	.70	1.00	.80@.90	.50@.60
Philadelphia	1.25	.90@1.00	.90@1.00	.75@.90	1.00	.90@1.00	.35@.45

enough to get in at lower levels may dispose of stocks around current prices, feeling that the somewhat uncertain character of the market is a warning for the exercise of great caution; consequently, stocks held by such persons may come on the market, and this, with profit taking and short selling and the absence of outside buying to support the selling, will undoubtedly exert a pressure on the market such as may bring about a further recession in quotations."

Price movements since July are shown by this list of index numbers

INDEX NUMBERS OF WHOLESALE PRICES

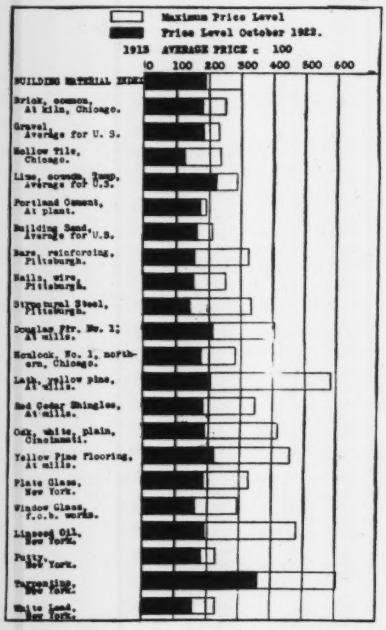
(Compiled by D. L. Bissell)

1922	July	Sept.	Nov.
Farm products	126	124	133
Crops	128	127	143
Live-stock	122	119	119
Orchard products	165	161	131
Citrus	100	138	85
Deciduous	211	175	162
Foods	140	136	142
Provisions	164	142	144
Dairy	117	139	168
Meats	127	124	123
Textiles and leather	193	187	206
Fuel and metals	155	157	149
Materials of construction	172	178	178
Building materials index, Dept. of Commerce	169.6	179.7	.....
E. N.-R. Constructiono Cost Index No.	169.7	185	188.6
All commodities	151	149	155
Raw materials	138	133	143
Manufactured products	164	166	167

by D. L. Bissell, San Diego, Calif., to which has been added the Building Materials Index of the Department of Commerce and the *E. N.-R.* Construction Cost Index.

New York incorporations thus far this year exceed the number for the whole of 1921, and will reach 17,000, establishing a record. Up to Dec. 1 there have been 16,301 companies, capitalized at $582,197,530.

Building materials index numbers issued by the Department of Commerce are shown for October and the 1920 peak in the chart. Shapes are


Maximum Price Level
Price Level October 1922.
1913 AVERAGE PRICE = 100
0 100 200 300 400 500 600
BUILDING MATERIAL INDEX
Brick, common, At kiln, Chicago.
Gravel, Average for U. S.
Hollow Tile, Chicago.
Lime, common, Susp. Average for U.S.
Portland Cement, At plant.
Building Sand, Average for U.S.
Bars, reinforcing, Pittsburgh.
Nails, wire, Pittsburgh.
Structural Steel, Pittsburgh.
Douglas Fir, No. 1; At mills.
Hemlock, No. 1, northern, Chicago.
Lath, yellow pine, At mills.
Red Cedar Shingles, At mills.
Oak, white, plain, Cincinnati.
Yellow Pine Flooring, At mills.
Plate Glass, New York.
Window Glass, f.o.b. works.
Linseed Oil, New York.
Putty, New York.
Turpentine, New York.
White Lead, New York.

shown to have dropped 60 per cent since the peak, cement 17, sand 23, gravel 22, common brick 23.

Bond market was firmer, probably due chiefly to slightly easier money. Municipals were quiet; new offerings small, but a much better volume in prospect.

Business failures in the United States in November numbered 1,758, an increase of 9.8 per cent over last month, according to Bradstreet's figures, but were 10.7 per cent fewer than in November, 1921. November liabilities totaled $54,080,825, which is 46 per cent heavier than for October, though 25.7 under November, 1921. For eleven months of this year failures number 20,548, an increase of 16.7 per cent over last year, which was the peak year in number of failures. Liabilities for the eleven months, however, are 11.2 per cent below the same period a year ago.

Bids Received for Towers of Philadelphia Bridge

Four bids were received by the Delaware River Bridge Joint Commission on Nov. 29 for the steel main towers of the Philadelphia-Camden suspension bridge. The material involved comprised 13,600,000 lb. of silicon steel, 4,890,000 lb. of carbon steel, and 290,000 lb. of cast steel. The unit prices bid ranged from 7.43c. to 9.55c. for silicon steel, 6.63 to 9.55c. for carbon, and 12.1c. to 18.08c. for cast steel.

The four bidders and their total bids on the estimated quantities were: Bethlehem Steel Co., $1,386,974; Keystone State Construction Co. and New York Shipbuilding Co., $1,469,304; McClintic-Marshall Co., $1,513,495; American Bridge Co., $1,805,670.

It is expected that the contract will be awarded to the low bidder.

Monthly Prices of Construction Materials

Ups and Downs of the Market

Pig-Iron—Prices continue to decline; but further increase in production is indicated. No. 2 foundry iron down $3.50 per ton in Birmingham, $1 in Chicago, and $6 in Pittsburgh. Basic dropped $2 in Philadelphia, $2.50 in Pittsburgh and $3 in Cincinnati. Bessemer declined $2 in Pittsburgh; Eastern Pennsylvania, $2 in Philadelphia during month.

Railway Supplies—Light rails down $4@$5 per ton at Pittsburgh, despite continued railroad buying of car and track materials. Red oak ties 5c. higher in St. Louis.

Pipe—Steel pipe trade showing increased volume; but no changes in mill or warehouse discounts. Cast-iron pipe up 50c. in Birmingham; $2.50 in Chicago and $3 per ton in San Francisco, since last month. Clay drain tile, higher in St. Louis. Advances in sewer pipe quoted in Atlanta, Dallas, St. Louis and Philadelphia; no declines reported.

Road and Paving Materials—Both bulk and package asphalt down 50c. in Boston and Maurer, N. J., and $1 per ton in St. Louis and Atlanta. San Francisco also reports drop of $2 in bulk and $2.50 in package asphalt. Detroit, however, quotes rise of $1.18 per ton in packages. No change in road oils. Wood paving blocks up 5c.@ 11c. per sq.yd. in New York; down 12c. in Philadelphia.

Sand, Gravel and Crushed Stone—Birmingham reports advance of 5c. per ton in sand, due to readjustment of freight rate prices; also higher in St. Louis, but down in Dallas and Atlanta. Gravel prices rose slightly in Denver, St. Louis and Dallas, and declined in Cincinnati, San Francisco and Atlanta, during month. Crushed stone declined 10c. per cu.yd. in San Francisco, and rose sharply in Cincinnati, Kansas City and Montreal.

Lime—Hydrated finishing lime advanced $2 per ton in St. Louis and $1 in Cincinnati; but dropped $2 in Chicago and $2.50 in Dallas. Hydrated common up $1 in Cincinnati and St. Louis, and $1.50 in Detroit. Lump finishing lime advanced 6c. per bbl. in Kansas City; common lump, $1.25 per ton in Detroit, 25c. per ton in St. Louis and 20c. per bbl. in Kansas City.

Cement—Mill prices unchanged during month. Kansas City, however, quotes $2.45 as against $2.85 per bbl. Detroit reports $2.47 as compared with $2.48 per bbl., one month ago, owing to correction in freight rate.

Structural Steel—Steel shapes, plates and bars still frequently quoted under the $2 per 100 lb. level. Independent makers, however, adhere to the $2 base on steel plates; with attractive tonnages on railway steel quoted as low as $1.90@$1.95. Heavy buying of tank plates for oil storage.

Brick and Hollow Tile—Common brick, $15@$15.50 as compared with $14@$15.50 per M. wholesale, alongside dock, New York, one month ago. Atlanta and Detroit both report declines of 50c., with a drop of $1 per M. in Dallas. San Francisco and Kansas City, however, quoted advances of 50c., with a rise of $1 in St. Louis. Hollow tile down in St. Louis, Minneapolis, Cincinnati and Kansas City; but higher in Atlanta and Montreal, due to heavy demand and high fuel costs.

Lumber—Although colder weather and an increase in surplus cars are expected to divert quotations downward, many cities report higher lumber prices during month. Yellow pine timbers, base sizes, up $3 in Dallas; $3.25 in Kansas City; $4 in Birmingham and $6.50 per M ft. b. m. in Philadelphia. Douglas fir rose $1 in Minneapolis and hemlock, $5 in Montreal. The declines were as follows: pine, $6 in Atlanta; fir, $1 in Seattle; fir, $2, hemlock, $5 and spruce, $6 per M. ft. in Philadelphia.

Scrap—Market weaker, due to seasonal dullness. St. Louis quotes reduction on all except cast borings.

Explosives—Average drop of 2c. per lb. in five out of eighteen cities reporting. St. Louis, however, quotes advance of 1c. on 60 per cent and Birmingham 1c. per lb. on both 40 and 60 per cent, during month.

Linseed Oil—Down 3c. in New York; up 1c. per gal. in Chicago, since last month. Price stable in other cities.

Price advances since last month are indicated by **heavy type**; declines by *italics*

PIG IRON—Per Gross Ton—Quotations compiled by The Matthew Addy Co.:

	Current	One Year Ago
CINCINNATI		
No. 2 Southern (silicon 2.25 @ 2.75)	*$27.55*	$22.50
Northern Basic	*30.27*	22.02
Southern Ohio No. 2 (silicon 1.75 @ 2.25)	*30.27*	23.52
NEW YORK, tidewater delivery		
Southern No. 2 (silicon 2.25 @ 2.75)	*35.27*	28.50
BIRMINGHAM		
No. 2 Foundry (silicon 2.25 @ 2.75)	*24.00*	18.00
PHILADELPHIA		
Eastern Pa., No. 2X, (2.25@2.75 sil.)	*31.64*	23.26
Virginia No. 2 (silicon 2.25 @ 2.75)	37.17	28.74
Basic	*27.50*	20.75
Gray Forge	*29.14*	22.50
CHICAGO		
No. 2 Foundry Local (silicon 1.75@2.25)	*30.00*	21.70
No. 2 Foundry Southern (silicon 2.25 @ 2.75)	*30.00*	24.66
PITTSBURGH, including freight charge from the Valley		
No. 2 Foundry Valley (silicon 1.75 @ 2.25)	*27.50*	22.46
Basic	*27.50*	20.96
Bessemer	*30.50*	21.96

RAILWAY SUPPLIES

STEEL RAILS—The following quotations are per ton f.o.b. Pittsburgh and Chicago for carload or larger lots. For less than carload lots 5c. per 100 lb. is charged extra:

	Pittsburgh				
	Current	One Year Ago	Birmingham	Chicago	St. Louis
Standard bessemer rails	$43.00	$40.00	.....	$43.00	43.00
Standard openhearth rails	43.00	40.00	$43.00	43.00	43.00
Light rails, 8 to 10 lb.	*40@43*	31@33	2.00*	43.00	**43.00**
Light rails, 12 to 14 lb.	*40@43*	31@33	2.00*	43.00	**43.00**
Light rails, 25 to 45 lb.	*40@43*	31@33	2.00*	43.00	**43.00**
Rerolled Rails	28@32	.....	.....	.....	.....

*Per 100 lb.

RAILWAY TIES—For fair-sized orders, the following prices per tie hold:

	6 In. x 8 In. by 8½ Ft.	7 In. x 9 In. by 8½ Ft.
Chicago, White Oak	$1.40	$1.55
Chicago, Hardwood and Red Oak	1.25	1.40
Chicago....Empty Cell Creosoting (add'l)	.45	.50
San Francisco..... Green Douglas Fir	*.84*	*1.17*
San Francisco, Empty Cell Creosoted, Douglas Fir	*1.60*	*2.25*
St. Louis, Red Oak*	**1.05**@1.30	**1.30@1.55**
St. Louis (creosoted) (zinc treated)	**1.70**	**2.05**

TRACK SUPPLIES—The following prices are base per 100 lb. f.o.b. Pittsburgh for carload lots, together with the warehouse prices at the places named:

	Pittsburgh					
	Current	One Year Ago	Chicago	St. Louis	San Francisco	Birmingham
Standard spikes, ⅝-in. and larger	$2.75	$2.25	$2.55	**$3.65**	$4.45	$3.29
Track bolts	3.85@4.50	3.25@3.50	3.65	**4.75**	5.45	4.29
Standard section angle bars	2.75	2.75	2.40	**3.50**	4.10	2.94

PIPE

WROUGHT PIPE—The following discounts are to jobbers for carload lots on the latest Pittsburgh basing card:

BUTT WELD

Inches	Steel Black	Steel Galv.	Inches	Iron Black	Iron Galv.
⅛ to 3	66	54½	¼ to 1¼	34	19

LAP WELD

⅛	59	47½	2	29	15
2½ to 6	63	51½	2½ to 4	32½	19
7 to 8	60	47½	4½ to 6	32½	19
9 to 12	59	46½	7 to 12	30	17

BUTT WELD, EXTRA STRONG, PLAIN ENDS

⅛ to 1¼	64	53½	¼ to 1¼	34	20
2 to 3	65	54½			

LAP WELD, EXTRA STRONG, PLAIN ENDS

⅛	57	46½	2	30	17
2½ to 4	61	50½	2½ to 4	33	21
4½ to 6	60	49½	4½ to 6	32	20
7 to 8	56	43½	7 to 8	25	13
9 to 12	50	37½	9 to 12	20	8

STEEL PIPE—From warehouses at the places named the following discounts hold for steel pipe:

	Black		
	New York	Chicago	St. Louis
⅛ to 3 in. butt welded	57%	62½%	61½%
2½ to 6 in. lap welded	54%	59½%	58½%

	Galvanized		
	New York	Chicago	St. Louis
⅛ to 3 in. butt welded	44%	48½%	51½%
2½ to 6 in. lap welded	41%	45½%	50½%

Malleable fittings, Class B and C, from New York stock sell at list less 10%. Cast iron, standard sizes, *32-5%* off.

CAST-IRON PIPE—The following are prices per net ton for carload lots:

Birmingham Mill	New York Current	New York One Year Ago	Chicago	St. Louis	San Francisco
4 in.	**$47.50@48**	*$59.30*	$50.30	**$55.20@56.20**	**$53.10**	**$58.00**
6 in. and over	43@**43.50**	*54.30*	47.30@48.30	**51.20@52.20**	**49.10**	**54.00**

Gas pipe and Class "A," $4 per ton extra; 16-ft. lengths, $1 per ton.

CLAY DRAIN TILE—The following prices are per 1000 lin.ft.:

Size, In.	New York Current	New York One Year Ago	St. Louis	Chicago	San Francisco	Dallas
3	$45.00	$40.00	**$55.00**	$50.00	.....	$55.00
4	55.00	50.00	**65.00**	60.00	$76.50	65.00
5	80.00	80.00	**84.00**	80.00	97.75	84.00
6	105.00	105.00	**110.00**	100.00	127.50	110.00
8	170.00	175.00	**181.00**	150.00	212.50	181.00

SEWER PIPE—The following prices are in cents per foot for standard pipe in car load lots, f.o.b., except as otherwise stated:

Size, In	New York Delivered	Pittsburgh	Birmingham	St. Louis	Chicago	San Francisco	Dallas
3	$0.14	$0.105	.....	.....	$0.12	$0.12	.....
4	.14	.105	$0.10	$0.0875	.12	.15	*$.175*
5	.20	.1575	.125	**.1225**	.18	.18	**.20**
6	.20	.1575	.150	**.16**	.18	.21	**.2625**
8	.34	.245	.225	.20	.28	.30	**.435**
10	.51	.3675	.2925	.28	.42	.42	.64
12	.65	.4725	.3825	.36	.54	.54	**.82**
15	1.03†	.63	.5625	.52	.72	.90	1.18
18	1.50†	.875	.765	.68	1.00	1.32	1.65
20	1.80†	1.05	1.0125	.92	1.20	.....	.....
22	2.40†	1.40	1.2375	.....	1.60	.....	2.10
24	2.70†	1.575	1.4625	1.20	1.80	2.16	**2.73**
27	4.50†	2.795	.....	2.25	3.75†	3.00	.....
30	5.00†	3.096	.....	2.70	**4.75†**	3.60	.....
33	6.50†	4.14	.....	3.35	5.50†	.....	.....
36	7.50†	4.715	.....	3.65	6.00†	.....	.....

	3	5	8	12	24	36
Boston	$0.13	$0.19	$0.29	$0.56	$2.43†	$6.46†
Minneapolis	.....	.....	.40	.72	2.55	5.66†
Denver	.135*	.18*	.27	.47	1.70	.....
Seattle	.13	.....	.325	.65†	2.34†	.....
Los Angeles	.....	.....	.....	.....	.....	.....
New Orleans	.1120*	.168*	.28	.476	1.82†	.....
Cincinnati	.111*	.1665	.259	.4995	1.665	3.7925†
Atlanta	**.108***	**.162***	**.27**	**.459**	**1.75**	.....
Montreal, *delivered*	.68‡	.45†	.70	1.35	4.50†	.....
Detroit	.102	.153	.238	.459	1.98†	6.15†
Baltimore	.1225	.2275	.35	.6870	2.29	5.23
Kansas City, Mo	.135	.19	.30	.54	2.16	.....
Philadelphia	**.12**	**.18**	**.28**	**.54**	**'1.80†**	**4.10†**

*4-in., 6-in., 9-in., respectively. †Double Strength. ‡3-in. special.

ROAD AND PAVING MATERIALS

ROAD OILS—Following are prices per gallon in tank cars 8,000 gal. minimum f.o.b. place named:

	Current	One Year Ago
New York, 45% asphalt (at terminal)	$0.06	$0.05½
New York, 65% asphalt (at terminal)	.06	.05
New York, binder (at terminal)	.06½	.08
New York, flux (at terminal)	.06½	.06½
New York, liquid asphalt (at terminal)	.07	.06½
St. Louis, 50@60% asphalt	**.07**	*.01½**
Chicago, 40–50% asphalt	.05½	.05
Chicago, 60–70% asphalt	.05†	.05½
Dallas, 45% asphalt	.040	.10
Dallas, 55% asphalt	.048	.13
Dallas, binder	.053	.15
San Francisco, binder, per ton	*9.50†*	15.00†

* Freight $21.75 per ton to Whiting, Ind.
† F.o.b. Oleum, Cal. Freight to San Francisco, 80c. per ton.

ASPHALT—Price per ton in packages (350-lb. bbl. or 425-lb. drums) and in bulk in carload lots, f.o.b. points listed:

	Package	Bulk
New York (*Mexican*)	$20.00	$16.00
Boston (*Mexican*)	*19.00*	*15.50*
Chicago (*Stanolind*)	26.00	22.00
San Francisco, *f.o.b. refinery*, Oleum, Cal.	*17.00**	*11.00**
Dallas, (*Texas*)	35.00	27.00
Seattle "*D*" *grade* (*California*)	23.75	13.00†
Denver (*California*)	40.00	....
Minneapolis *f.o.b. Twin Cities* (*Mexican*)	33.00	27.50
St. Louis (*Mexican*)	*25.00*	*21.00*
Baltimore (*Mexican*)	20.00	16.00
Los Angeles, *at factory, Bakersfield* (*California*)	....	....
Montreal (*Mexican*)	28.00	21.00
Atlanta (*Mexican*)	*22.00*	*16.50*
Detroit (*Mexican*)	**23.68**	*18.95*
Cincinnati (*Mexican*)	22.50	19.50
Maurer, N. J. (*Trinidad and Bermudez*)	*28.00*	*26.00*
Maurer, N. J. (*Mexican*)	18.00	15.50
Philadelphia (*Mexican*)	20.00	16.00
Kansas City, *petroleum*	28.83	**22.83**

*Freight to San Francisco, 80c. per ton.

†F.o.b. Richmond, Cal.

NOTE—Barrels or drums are optional in most cities. About 6 bbls. to the ton, and from 4 to 5 drums.

PAVING STONE—

New York *delivered*	5-in. granite, 28@29 blocks per sq.yd.	$135.00 per M
Chicago	About 4x8x4 dressed	3.35 sq.yd.
	About 4x8x4 common	3.10 sq.yd.
San Francisco	Basalt block 4x7x8	70.00 per M
Boston	5-in. granite	2.00 per sq.yd.
Atlanta	Granite	2.10 sq.yd.
Detroit	Granite, 26½ blocks per sq.yd.	100.00 per M
Baltimore	Granite	2.00 sq.yd.
Montreal *delivered*	Granite	100.00 per M
New Orleans	Granite, 4 x 8 x 4	3.25 sq.yd.
Cincinnati	Granite	1.35 per M.
St. Louis	4x8x4 dressed	3.10 sq.yd.
	4x8x4 common	2.90 sq.yd.
Kansas City	No. Granite	3.95 sq.yd.
Philadelphia	Granite	128.00 per M.

FLAGGING—

New York	Bronx, 5 ft.	$0.30@35	sq.ft.
	Manhattan, 4 ft.	.26	sq.ft.
	Queens, 5 ft.	.26	sq.ft.
	6x20-in. cross-walk	1.00	lin.ft.
Chicago	18 in. wide	.99	lin.ft.

CURBING—Bluestone per lineal foot, in New York, costs 77c.@85c. for 5x16 in.; 88c. for 5x18 in., in cargo lots. 5x18 in., 1.44c. per lin.ft. delivered in St. Louis. 6x18 in., Chicago, $2 per lin.ft.

WOOD BLOCK PAVING—

	Size of Block	Treatment	Per Sq.Yd.
New York (*delivered*)	3	16	**$2.21**
New York (*delivered*)	3½	16	**2.39**
New York (*delivered*)	4	16	**2.77**
Boston	3½	16	2.32
Chicago	4	16	3.00@3.25
Chicago	3½	16	2.50
St. Louis	3½	16	2.00
St. Louis	4	16	2.00
Seattle	4	16	Off market
Minneapolis	3½	16	2.09
Atlanta	3½	16	2.30
New Orleans	3	16	1.70
New Orleans	3½	16	1.95
New Orleans	4	16	2.25
Dallas	4	18	3.90
Baltimore	3½	16	3.44
Montreal	4	16	4.50
Detroit	3	16	2.84
Detroit	4	16	3.00
Cincinnati	4	16	2.35
Kansas City	4	16	3.25
Philadelphia	3½	16	*2.48*

CONSTRUCTION MATERIALS

SAND AND GRAVEL—Price for cargo or carload lots to contractor is as follows, per cu.yd.:

	Gravel 1½ In. Current	Gravel 1½ In. One Year Ago	Gravel ¾ In. Current	Gravel ¾ In. One Year Ago	Sand Current	Sand One Year Ago
New York	$2.00	$1.75	$2.00	$1.75	$1.00	$1.00
Denver	**1.90**	2.50	**1.90**	2.50	1.30	1.10
Chicago	2.25	2.00	2.25	2.00	2.25	2.00
St. Louis, *per ton*	**1.45**	1.30	**1.50**	1.25	**1.45**	1.20*
Seattle	1.00	1.50	1.00	1.50	1.00	1.50
Dallas	**2.52**	2.25	**2.52**	2.25	*1.87½*	2.25
Minneapolis	1.75	1.50	1.75	1.50	1.00	0.50†
Cincinnati	1.40	*1.87½*	*1.15*	2.03	1.15	1.60
San Francisco	*2.15*	2.25	*2.15*	2.25	1.50	1.50
Boston	1.40	2.65	1.40	2.65	1.10	2.00
New Orleans	2.85	2.85	2.85	....	1.35	1.35
Los Angeles, per ton	....	1.35	....	1.35	....	1.20
Atlanta, per ton	*1.75*	1.85	*1.75*	1.85	*1.32*	1.25
Detroit	2@2.25	2.00	2@2.25	2.00	2.00	2.00
Baltimore, per ton	1.40	1.40	1.60	1.60	0.70†	2.40
Montreal, per ton	1.25	1.25	1.50	1.50	1.25	1.25
Birmingham, per ton (Crushed slag used instead of gravel)					**1.25**	1.28
Philadelphia	1.70	1.40	1.75	1.55	1.65	1.90
Kansas City, per ton	2.00‡	....	2.00‡	....	0.66†	....

New York—Grit, $1.75 per cu. yd.

Los Angeles—Freight from quarry, 85c. per ton, and is included in above price.

* Fine white sand: Pacific, $4 per ton; Ottawa, $4.50.

† At pit.

‡ Per cu. yd.

CRUSHED STONE—Price for cargo or carload lots f.o.b. city, unless stated otherwise, is as follows, per cu.yd.:

	1½ In. Current	1½ In. One Year Ago	¾ In. Current	¾ In. One Year Ago
New York	$1.65	$1.80@1.90	$1.75	$1.80@1.90
Chicago	2.25	1.60	2.25	1.60
St. Louis *delivered*	2.10	1.55*	2.20	1.55*
Dallas	1.65	3.20	1.65	3.20
San Francisco	*2.15*	2.25	*2.15*	2.25
Boston, *delivered*	1.65	3.00*	1.65	3.00*
Minneapolis, *at plant*	2.00	2.00	2.25	2.25
Kansas City	**2.40**	2.75	**2.40**	2.75
Denver	3.50	3.50	3.50	3.50
Seattle *delivered*	3.00	3.00	3.00	3.00
Atlanta	2.10*	2.00*	2.10*	2.00*
Cincinnati *delivered*	**1.95***	2.37½	**1.95***	2.08
Los Angeles	....	1.60*	....	1.70*
Detroit	1.90@2*	1.90*	1.90@2*	1.90*
Baltimore	1.70*	1.75*	1.60*	1.65*
Montreal	**1.80***	2.00*	1.90*	2.10*
Birmingham *delivered*	3.20	3.20	3.10	3.10
Phildelphia	1.75*	1.70	1.60*	1.60
Pittsburgh	2.85	....	2.85	....
Cleveland	3.00*	....	3.00*	....

*Per ton.

CRUSHED SLAG—Price of crushed slag in carload lots, per net ton, at plants:

	1½-In.	¾-In.	Roofing	Sand
Youngstown District	$1.30	$1.30	$2.00	$1.30
Steubenville District	1.40	1.40	2.00	1.40
Ironton District	1.40	1.40	2.00	1.40
East Canaan, Conn.	1.25	1.35	4.00	1.00
Easton, Catasaqua, Pa.	1.00	1.00	2.00	0.90
Birmingham, Ala.	**1.25**	**1.25**	**1.25**	**1.25**
Buffalo, N. Y., and Erie, Pa.	1.25	1.25	2.25	1.25
Cleveland, Ohio	1.20	1.20	....	1.00
Eastern Pennsylvania and Northern New Jersey	1.20	1.20	2.00	1.20
Western Pennsylvania	1.25	1.25	2.00	1.25

LIME—Warehouse prices:

	Hydrated, per Ton Finishing	Hydrated, per Ton Common	Lump, per Barrel Finishing	Lump, per Barrel Common
New York	$16.80@*17.10*	$13.10	$3.63½*	$2.75@$3.13½*
Chicago	*18.00*	18.00	1.50†	1.40†
St. Louis	**32.20**	**20.00**	....	**18.00‡**
Boston	17.00	13.00	3.75*	2.90*
Dallas	*22.50*	....	....	2.50†
Cincinnati	**15.80**	**13.30**	....	10.75‡
San Francisco	22.00	16.00	....	1.75†
Minneapolis	25.50	22.00 (white)	1.70†	1.40†
Denver	24.00	....	....	2.70†
Detroit	**19.50**	**17.50**	....	**18.25‡**
Seattle *paper sacks*	24.00	.....	2.80†	.....
Los Angeles	....	....	....	....
Baltimore	21.00	15.75	....	15.00‡
Montreal	21.00	21.00	15.00‡	11.00‡
Atlanta	23.00	13.00	2.25†	1.85†
New Orleans	....	17.25	2.40†	....
Philadelphia	15.50	14.50	13.00‡	12.00‡
Kansas City	25.60	24.00	**2.40†**	**2.40†**

*Per 280-lb. bbl. (net). †Per 180-lb. bbl. (net). ‡Per ton—Refund of 10c. per bbl. Minneapolis quotes brown common lump lime; Kelly Is. white is $1.55, Sheboygan $1.45. New York quotes hydrated lime "on cars" in paper sacks; lump lime "alongside dealers docks" or "on cars."

NATURAL CEMENT—Price to dealers per bbl. for 500 bbl. or over, f.o.b., exclusive of bags:

	Current	One Year Ago
Minneapolis (Rosendale)	$2.80	$2.80
Kansas City (Ft. Scott)	*1.50*	1.60
Atlanta (Magnolia)	11.00 ton	11.00
Cincinnati (Utica)	1.72	1.77
Boston (Rosendale) per bag	....	0.85@0.95
St. Louis (Carney)	*1.75*	....

PORTLAND CEMENT—Prices to contractors per bbl. in carload lots f.o.b. points listed *without bags*. Cash discount not deducted.

	Dec. 7	One Month Ago	One Year Ago
New York, del. by truck	$2.60	$2.60	$2.40
New York, alongside dock to dealers	2.30	2.30	2.10
Jersey City	*2.48*	2.73	2.13
Boston	2.85	....	2.61
Chicago	2.20	2.20	1.97
Pittsburgh	2.24	2.24	2.02
Cleveland	2.46	2.46	2.28
Detroit	*2.47*	2.48	2.31
Indianapolis	2.41	2.41	2.23
Toledo	2.48	2.48	2.31
Milwaukee	2.37	2.37	2.19
Duluth	2.14	2.14	1.95
Peoria	2.39	2.39	2.14
Cedar Rapids	2.45	2.45	2.28
Davenport	2.43	2.43	2.22
St. Louis	2.35	2.35	1.97
San Francisco	2.71	2.71	2.84
New Orleans	3.30	3.30	2.88
Minneapolis	2.39	2.39	2.26
Denver	2.85	2.85	3.10
Seattle	2.90	2.90	3.10
Dallas	2.25	2.25	2.55
Atlanta	2.54	2.54	2.69
Cincinnati	2.51	2.51	2.37
Los Angeles	....	....	3.31
Baltimore	2.90	2.90	2.88
Birmingham	2.40	2.40	2.27
Kansas City	*2.45*	2.85	2.45
Montreal	2.88	2.88	3.12
Philadelphia	2.51	2.51	2.50
St. Paul	2.39	2.39	2.26

NOTE—Bags 10c. each, 40c. per bbl.;

Current mill-prices per barrel in carload lots, without bags; to contractors:

Buffington, Ind.	$1.95	Mason City, Ia.	$2.05
Universal, Pa.	2.00	La Salle, Ill.	2.05
Steelton, Minn.	1.95	Hudson, N. Y.	2.20
Fordwick, Va.	2.20	Leeds, Ala.	2.20
Mitchell, Ind.	2.05	Hannibal, Mo.	2.10
Iola, Kan.	2.10	Lehigh Valley District	2.10

TRIANGLE MESH—Price per 100 sq.ft. in carload lots:

PLAIN 4-INCH BY 4-INCH MESH

Style Number	Weight in Pounds per 100 sq.ft.	Pittsburgh, Mill	Warehouse: New York	Chicago	Dallas	San Francisco
032	22	$0.85	$0.95	$0.92	$1.172	$1.03
049	28	1.08	1.23	1.18	1.488	1.34
068	35	1.31	1.48	1.43	1.835	1.64
093	45	1.69	1.91	1.84	2.345	2.10
126	57	2.08	2.35	2.27	2.917	2.60
153	68	2.48	2.81	2.71	3.468	.....
180	78	2.85	3.22	3.12	4.08	.....
245	103	3.76	4.25	4.11	5.253	.....
287	119	4.34	4.90	4.74	6.079	5.43
336	138	5.04	5.69	5.51	7.458	.....
395	160	5.84	6.60	6.38	8.16	.....
			PAVING			
036P	17	$0.65	$0.72	$0.71	$0.897	.....
053P	24	.91	1.02	.99	1.284	.....
072P	31	1.15	1.29	1.26	1.601	.....
097P	40	1.48	1.67	1.62	2.06	.....
049R	24	.91	1.02	.99	1.264	.....
067R	31	1.15	1.29	1.26	1.601	.....
089R	40	1.48	1.67	1.62	2.06	.....

In rolls 16-, 20-, 24-, 28-, 32-, 36-, 40-, 44-, 48-, 52-, and 56-in. wide and in 150-, 200- and 300-ft. lengths. Galvanized is about 15% higher. Size of roll carried in New York warehouses, 48 in wide x 150 ft. long, or 600 sq. ft.

EXPANDED METAL LATH—Prices in carload lots per 100 yd. for painted are as follows:

Gage	Weight	*New York	Chicago	St. Louis	San Francisco	Dallas
27Dia.	2.3	$22.00	$20.39	$20.22	$20.78	$25.50
26 "	2.5	22.00	21.93	21.64	21.43	27.58
25 "	3.0	22.00	24.45	24.28	.....	30.71
24 "	3.4	24.00	26.33	26.10	24.28	33.16
22 "	4.33	27.00	31.06	31.60	.....	35.10

* Price to contractors at warehouse or delivered on job in Manhattan, Bronx or Brooklyn.

BARS, CONCRETE REINFORCING—Current quotations per 100 lb.:

ROLLED FROM BILLETS

Inches	Pittsburgh Mill	Birmingham Mill	Warehouse, Uncut: New York	Chicago	St. Louis	Dallas	San Francisco
½ and larger	$2.00@2.15	$2.35	$3.04	$2.92	2.75	$4.00	$3.35
⅝	2.05@2.20	2.45	3.09	2.97	2.80	4.05	3.40
¾	2.10@2.25	2.55	3.14	3.02	2.85	4.10	3.45
⅞	2.25@2.40	2.60	3.19	3.17	2.95	4.15	3.60
1	2.50@2.65	2.65	3.54	3.42	3.20	4.40	3.85

Includes 15c charge for cutting to lengths of 2 ft. and over.
Twisted bars cut to length take extra of 27½c. per 100 lb.

ROLLED FROM RAILS

	Chicago	St. Louis	Dallas		Chicago	St. Louis	Dallas
½ and larger	$2.10	$2.45	$3.50	⅝	$2.35	$2.75	$3.95
¾ in.....	2.15	2.50	3.75	1	2.60	3.00	4.20
⅞	2.20	2.55	3.80	.....	.....	.....	.....

BRICK—Contractors price per 1,000 in cargo or carload lots is as follows:

	Common: Current*	One Month Ago	One Year Ago	Paving Block: 3-inch*	4-inch*
New York (del.)	$18.00@18.55	$16.90@18.55	$18.40	$42.00†	$50.00†
New York (at dock)	15@15.50	14@15.50	15.00	.....	.....
Chicago	11.00	11.00	11.00	34.00	42.00
St. Louis, salmon	15.00	14.00	17.00	35.50	40.00
Denver, salmon	12.00	12.00	14.00	.....	.....
Dallas	9.90	10.90	12.72	no market	
San Francisco	15.50	15.00	18.00	.....	.....
Los Angeles (del.)	.....	.....	15.50	(not used)	
Boston (del.)	22.00	.....	17.00	44.00†	53.00†
Minneapolis (del.)	18@19	18@19	17.00	.....	43.00
Kansas City	14.50	14.00	14.50	.....	.....
Seattle	14.00	14.00	14.00	44.00	.....
Cincinnati	17.00	17.00	18.00	42.00	41.00
Montreal	16.00	16.00	16.00	.....	68.00
Detroit (del.)	17.00	16.50@17.50	15.00	36.50	39.50@41
Baltimore (del.)	20.00	20.00	20.00	36.00‡	.....
Atlanta	11.50	12.00	9.00	39.00	.....
New Orleans	15.75	15.75	14.00	.....	.....
Birmingham	12.50	12.50	11.50	.....	.....
Philadelphia	20@28	20@28	16@19	40.00	48.00
Pittsburgh (del.)	16.00	16.00	.....	.....	.....
Cleveland	16.00	16.00	.....	.....	.....

* For paving blocks 3½x8½x3 and 3½x8½x4 respectively. † F.o.b. ‡ Vitrified, f.o.b. plant, Baltimore.

HOLLOW TILE—Price per block in carload lots to contractor for hollow building tile.

	New York: Current on Trucks*	New York: One Year Ago	Chicago	Philadelphia	St. Louis	San Francisco	Perth Amboy N. J., Factory*
4x12x12	$0.123	$0.1112	$0.0674	$0.12	$0.08	$0.108	.....
6x12x12	.1844	.1516	.0926	.....	.114	.156	.....
8x12x12	.2305	.2021	.1263	.1875	.16	.244	$0.2147
10x12x12	.....	.....	.1621	.....	.18	.....	.2653
12x12x12	.....	.....	.1853	.....	.22	.....	.3448

* 5 per. off for cash.

	4x12x12	8x12x12	12x12x12
Boston	$0.1027	$0.1926	.....
Minneapolis (f.o.b. cars)	.0696	.115	$0.204
Minneapolis (delivered)	.0796	.13065	.229
Cincinnati	.0859	.1611	.....
Kansas City	.083	.105	.....
Denver	.065	.123	.188
Seattle (delivered)	.11	.25	.36
Los Angeles factory	.....	.....	.....
New Orleans	.12	.23	.36
Detroit (delivered)	.09	.175	.260
Montreal	.09	.16	.30
Baltimore	.14	.25	.39
Atlanta	.0859	.16110	.....
Dallas	.115	.....	.....
Birmingham	.11	.18	.....
Pittsburgh (delivered)	.068	.128	.179
Cleveland	.08	.164	.....

San Francisco, Philadelphia, Atlanta, New York and Chicago quote on hollow partition tile.

STRUCTURAL MATERIAL—Following are base prices f. o. b. mill, Pittsburg and Birmingham together with quotations per 100 lb. from warehouses at place named:

	Pittsburgh, Mill	Birmingham Mill	Warehouse: New York	Dallas	St. Louis	Chicago	San Francisco
Beams, 3 to 15 in.	$2.00	$2.40	$3.14	$4.40	$3.00	$3.02½	$3.25
Channel, 3 to 15 in.	2.00	2.40	3.14	4.40	3.00	3.02½	3.25
Angles, 3 to 6 in., ¼ in. thick	2.00	2.40	3.14	4.40	3.00	3.02½	3.25
Tees, 3 in. and larger	2.00	2.40	3.14	4.40	3.05	3.02½	3.25
Plates	2.00	2.40	3.14	4.50	3.00	3.02½	3.35

RIVETS—The following quotations are per 100 lb.:

STRUCTURAL

	Warehouse: Pittsburgh, Mill	New York: Current	New York: One Yr. Ago	Chicago	St. Louis	San Francisco	Dallas
½ in. and larger	$3@3.15	$3.85	$3.70	$3.75	$3.85	$4.75	$6.00

CONE HEAD BOILER

½ in. and larger	3.10@3.25	3.95	3.80	3.85	3.95	4.85	6.15
⅝ and ¾.....	3.25@3.40	4.11	3.95	4.00	3.95	5.00	6.30
⅞ and 1.....	3.50@3.65	4.35	4.20	4.25	3.95	5.25	6.55

Lengths shorter than 1 in. take an extra of 50c. Lengths between 1 in. and 2 in. take an extra of 25c.

NAILS—The following quotations are per keg from warehouse:

	Pittsburgh, Mill	Chicago	San Francisco	Dallas	St. Louis	Montreal
Wire	$2.70	$3.45	$4.00	$4.40	$3.40	$4.95
Cut	3.35	5.50	5.65	7.75	5.50	5.00

PREPARED ROOFINGS—Standard grade rubbered surface, complete with nails and cement, costs per square, f.o.b., as follows:

	New York: 1-Ply l.c.l.	New York: 2-Ply l.c.l.	New York: 3-Ply l.c.l.	Philadelphia: 1-Ply l.c.l.	Philadelphia: 2-Ply l.c.l.	Philadelphia: 3-Ply l.c.l.
No. 1 grade	$2.10	$2.55	$3.00	$1.90	$2.35	$2.80
No. 2 grade	1.85	2.15	2.55	1.70	2.00	2.40

Slate-surfaced roofing (red and green) in rolls of 108 sq.ft. costs $1.95 per roll in carload lots and $2.20 for smaller quantities f.o.b. Philadelphia.

Single shingles, red and green slate finish, cost $5.50 per package (sufficient to cover 50 sq.ft.) in carloads; $5.75 in smaller quantities, in Philadelphia. Strip shingles (4 in 1) f.o.b. Philadelphia. l.c.l., $5.90

ROOFING MATERIALS—Prices f.o.b. New York:

Tar felt (14 lb. per square of 100 sq.ft.) per roll of 432 sq.ft.	$2.00
Tar pitch (in 400-lb. bbl.), per 100 lb.	1.65
Asphalt roofing (in barrels), per ton, f.o.b. plant*	40.50
Asphalt felt (light), per ton, f.o.b. plant*	64.50
Asphalt felt (heavy), per ton, f.o.b. plant*	68.50

* Delivered in Metropolitan Dist., $3.00 additional.

SHEETS—Quotations are per 100 lb. in various cities from warehouse also the base quotations from mill:

Blue Annealed	Pittsburgh, Large Mill Lots	St. Louis	Chicago	San Francisco	New York
No. 10	$2.50@2.60	4.10	$4.00	$4.35	$4.19
No. 12	2.60@2.70	4.15	4.05	4.40	4.24
No. 14	2.70@2.75	4.20	4.10	4.45	4.29
No. 16	2.90@3.05	4.30	4.20	4.55	4.39
Black					
*Nos. 18 and 20	3.20@3.25	4.65	4.70	5.70	4.70
*Nos. 22 and 24	3.25@3.30	4.70	4.70	5.75	4.75
*No. 26	3.30@3.35	4.75	4.75	5.80	4.80
*No. 28	3.35@3.40	4.85	4.85	5.90	4.90
Galvanized					
No. 10	3.35@3.50	4.85	4.85	.....	4.90
No. 12	3.45@3.60	4.95	4.95	5.85	5.00
No. 14	3.45@3.60	4.95	4.95	5.85	5.00
Nos. 17 to 21	3.75@3.90	5.10	.....	6.15	5.30
Nos. 22 and 24	3.90@4.05	5.40	5.40	6.30	5.45
*Nos. 25 and 26	4.05@4.20	5.55	5.55	6.45	5.60
*No. 28	4.35@4.50	5.85	5.90	6.75	5.90

*For painted corrugated sheets add 30c. per 1,000 lb. for 5 to 28 gage; 25c. for 19 to 24 gages; for galvanized corrugated sheets add 15c., all gages.

LINSEED OIL—These prices are per gallon:

	New York: Current	New York: One Year Ago	Chicago: Current	Chicago: One Year Ago
Raw in barrel (5 bbl. lots)	$0.90	$0.72	$0.95	$0.76

WHITE AND RED LEAD—Base price in cents per pound:

	Red				White	
	Current		1 Year Ago		Current	Yr. Ago
	Dry	In Oil	Dry	In Oil	Dry or In Oil	Dry or In Oil
100-lb. keg	13 25	14 75	12 25	14 75	13 25	12 25
25 and 50-lb. kegs	13 50	15 00	12 50	14 00	13 50	12 50
12½-lb. keg	13 75	15 25	12 75	14 25	13 75	12 75
5-lb. cans	16 25	17 75	15 25	16 75	16 25	15 25
1-lb. cans	18 25	19 75	17 25	18 75	18 25	17 25

LUMBER

Prices wholesale, per M. ft. b.m., to dealers in carload lots, f.o.b.

San Francisco—Prices of rough Douglas fir No. 1 common, in carload lots to dealers at yards. To contractors, $2 per M ft. additional.

	6–8 and 12 Ft.	10–16–18 and 20 Ft.	22 and 24 Ft.	25 to 32 Ft.
3x3 and 4	$30 00	$33 00	$33 00	$35 00
3x6 and 8	30 00	33 00	33 00	36 00
4x4-6 and 8	30 00	33 00	34 00	37 00
3x10 and 12	30 00	35 00	34 00	38 00
3x14	34 00	35 00	36 00	38 00
4x10 and 12	30 00	33 00	34 00	37 00
4x14	34 00	35 00	36 00	38 00

	24 Ft. and Under	25 to 32 Ft.	33 to 40 Ft
6x10	$32 00	$35 00	$37 00
6x14	34 00	37 00	39 00
8x10	32 00	35 00	37 00
8x14	34 00	37 00	39 00

New York and Chicago—Wholesale prices to dealers of long leaf yellow pine.

	New York*		Chicago	
	20 Ft. and Under	22–24 Ft.	20 Ft. and Under	22–24 Ft
3x 4 to 8x8	$47 00	$48 00	**$46 00**	**$48 00**
3x10 to 10x10	50 00	51 00	**49 00**	**51 00**
3x12 to 12x12	54 00	55 00	**52 00**	**54 00**
3x14 to 14x14	60 00	61 00	**57 00**	**59 00**
3x16 to 16x16	67 00	68 00	**61 00**	**63 00**
3x18 to 18x18	80 00	81 00	**68 00**	**70 00**
4x20 to 20x20	90 00	91 00	**78 00**	**80 00**

*Wholesale price to dealers; to contractors, delivered from lighters or cars to job, $5 additional. Short leaf pine up to 14 x 14 costs $15 per M. less.

Over 24 ft.—Add $1 for each additional 2 ft. in length up to 30 ft. for sizes 12 x 12 and under, for sizes over 12 x 12 add $2, for merchantable add $2 to sizes 14 x 10 and under. For pine add $2 to the price of merchantable for all sizes.

Other Cities

	8 x 8-In. x 20 Ft. and Under				12 x 12-In. 20 Ft. and Under	
	P.	Fir	Hemlock	Spruce	P.	Fir
Boston	$55 00	$100 00	.....	$55 00	$65 00	$110 00
Seattle	.....	*22 00*	.....	.....	.....	*23 50*
New Orleans	30 00	.....	.....	.....	35 00	.....
Baltimore	58 00	.....	.....	.....	70 00	.....
Cincinnati	**44 00**	48 50	$48 50	.....	**57 50**	50 50
Montreal	50 00	50 00	**40 00**	38 00	78 00	50 00
Los Angeles	.....	.....	.....	.....	.....	.....
Denver	.....	**39 75**	38 75	38 75	.....	39 75
Minneapolis	47 00	**40 75**	*41 00*	.....	50 00	**40 75**
Atlanta	*35 00*	.....	.....	.....	*36 00*	.....
Dallas	45 00	.....	.....	.....	**48 00**	.....
Kansas City	*38 75*	47 00	47 00	49 50	**52 75**	.....
Birmingham	**32 00**	.....	.....	.....	**40 00**	.....
Philadelphia	**44 00**	38 00	*40 00*	*44 00*	**55 00**	*38 00*
Detroit	44 75	46 75	.....	.....	53 75	46 75
St. Louis	44 00	.....	.....	.....	51 00	.....

	1-In. Rough, 10 In. x 16 Ft.— and Under			2-In. T. and Gr. 10 In. x 16 Ft.	
	P.	Fir	Hemlock	P.	Fir
Boston	$45 00	.....	$45 00	$50 00	.....
Seattle	.....	*$14 50*	.....	.....	*$15 50*
New Orleans, at mill	70 00	.....	.....	37 00	.....
Baltimore	40 00	.....	.....	40 00	.....
Cincinnati	*37 50*	*78 25*	68 25	*34 00*	78 25
Montreal	66 00	45 00	27 00	45 00	45 00
Los Angeles	.....	.....	.....	.....	.....
Denver	.....	30 25	30 25	.....	33 25
Minneapolis	48 50	**39 25**	38 00	43 75	**38 25**
Atlanta	*18 50*	.....	.....	28 00	.....
Dallas	**45 00**	36 00	.....	48 60	.....
Kansas City	**77 00**	*38 50*	*38 50*	**74 00**	40 00
Birmingham	**28 00**	.....	.....	30 00	.....
Philadelphia	**34 00**	**40 00**	*40 00*	**44 00**	38 00
Detroit	**48 25**	39 50	.....	45 00	*39 75*
St. Louis	**76 00**	.....	.....	50 00	.....

Montreal—Up to 32 ft.; over which, $3.00 per M. ft. increase up to 30 ft.

Birmingham—Quotes carload lots, f.o.b. sidings. $1.50 additional per M. ft. to contractors.

Boston and Cincinnati—Prices to contractors in carload lots, f.o.b.

Denver—Quotes dealers prices to contractors on large projects.

St. Louis—Wholesale price to contractors, $7@$11 per M. ft. additional.

Seattle—Price to contractors, delivered.

Dallas—Wholesale to contractors, $10 per M. ft. additional.

FREIGHT RATES

On finished steel products in the Pittsburgh district, including plates, structural shapes, merchant steel, bars, pipe fittings, plain and galvanized wire nails, rivets, spikes, bolts, flat sheets (except planished), chains, etc., the following freight rates are effective in cents per 100 lb., in carloads of 36,000 lb.:

Baltimore	$0.315	Detroit	$0.295
Birmingham	.69	Kansas City	.735
Boston	.365	New Orleans	.515
Buffalo	.265	New York	.34
Chicago	.34	Pacific Coast (all rail)	1.50†
Cincinnati	.295	Philadelphia	.325
Cleveland	.215	St. Louis	.43
Denver	1.275*	St. Paul	.595

* Minimum carload, 40,000 lb.

†Minimum carload, 50,000 lb., structural steel only; 80,000, lb. for other iron or steel products.

CONTRACTORS' SUPPLIES

STEEL SHEETPILING—The following price is base per 100 lb. f. o. b. Pittsburgh, with a comparison of a month and a year ago:

Current	One Month Ago	One Year Ago
$2.50	$2.50	$1.80@1.90

WIRE ROPE—Discounts from list price on regular grades of bright and galvanized are as follows:

	Eastern Territory New York and East of Missouri River
Hercules red strand, all constructions	25%
Patent flattened strand, special and cast steel	25%
Patent flattened strand, iron rope	10%
Plow steel round strand rope	40%
Special steel round strand rope	35%
Cast steel round strand rope	27½%
Round strand iron and iron tiller	10%
Galvanized steel rigging and guy rope	12½%
Galvanized iron rigging and guy rope	+7½%

California, Oregon, Nevada and Washington Discount 5 points less than discount for Eastern territory.

Wyoming, New Mexico and Colorado: Discount 5 points less than discount for Eastern territory.

Arizona: Discount 10 points less than discount for Eastern territory.

Montana, Idaho and Utah: Discount 10 points less than discount for Eastern territory.

North Dakota, Nebraska, Kansas, Oklahoma and Texas: Discount 5 points less than discount for Eastern territory.

MANILA ROPE—For rope smaller than ¾-in. the price is ½ to 2c. extra; while for quantities amounting to less than 600 ft., there is an extra charge of 1c. The number of feet per pound for the various sizes is as follows: ¾-in., 8 ft., ¾-in., 6; ⅞-in., 4½; 1-in., 3½; 1¼-in., 2 ft. 10 in.; 1½-in., 2 ft. 4 in. Following is price per pound for ¾-in. and larger, in 1200-ft. coils:

Boston	$0.17	New Orleans	$0.17½
New York	.17	Los Angeles	.....
Chicago	*.18*	Seattle	.18
Minneapolis	*.18½*	St. Louis	*.16½*
San Francisco	.16	Montreal	.30
Atlanta	.20	Detroit	.19
Denver	.20	Baltimore	.17
Cincinnati	.19	Kansas City	.19½
Dallas	*.22*	Birmingham	.20½
Philadelphia	*.18½*		

EXPLOSIVES—Price per pound of dynamite in small lots:

	Gelatin	
	40%	60%
New York	$0.27	$0.30
Boston	.22	.24
Kansas City	*.2125*	*.2325*
Seattle	.165	.195
Chicago	*.22*	*.25*
Minneapolis	.189	.2094
St. Louis	.22	.25
Denver	.2025	.2325
Dallas	*.23*	*.25*
Los Angeles	.....	.....
Atlanta	*.23*	*.26*
Baltimore	.195	.225
Cincinnati	*.215*	*.245*
Montreal	.195	.235
Birmingham, *delivered*	.20	.22
New Orleans	.235	.265
San Francisco	*.1625*	*.1925*
Philadelphia	.2475	.28

PILES—Prices per lineal foot, pine piles with bark on, f.o.b. New York.

Diameters	Points	Length	Barge	Rail
12 in. at butt	6 in.	30 to 50 ft.	$0.13	$0.17½
12 in.—2 ft. from butt	6 in.	50 to 59 ft.	0.17½	0.22
12 in.—2 ft. from butt	6 in.	60 to 69 ft.	0.19½	0.24
14 in.—2 ft. from butt	6 in.	50 to 69 ft.	0.23	0.32
14 in.—2 ft. from butt	6 in.	70 to 79 ft.	0.25	0.34
14 in.—2 ft. from butt	5 in.	80 to 89 ft.	0.32	0.38

SCRAP—The prices following are per gross ton paid to dealers and producers f.o.b. New York. In Chicago and St. Louis the quotations are per net ton and cover delivery at the buyer's works, including freight transfer charges.

	New York	Chicago	St. Louis
No. 1 railroad wrought	$14.50	$11.50	*$14.75*
Stove plate	13.50	12.00	*13.50*
No. 1 machinery cast	18.00	16.50	*17.00*
Machine shop turnings	9.00	4.00	*9.00*
Cast borings	12.00	5.50	10.50
Railroad malleable cast	15.00	12.50	*17.00*
Re-rolling rails	16.00	13.00	*15.50*
Relaying rails	28.50	30.00	25@30

SHIP SPIKES—Current prices per 100 lb.:

In.	San Francisco Galv.	San Francisco Black	Seattle Black
½	$6.75	$5.50	*$8.00*
⅝	6.30	5.05	*7.75*
¾	6.15	4.90	*7.70*

Pittsburgh base in lots of 200 kegs or more $3.50.